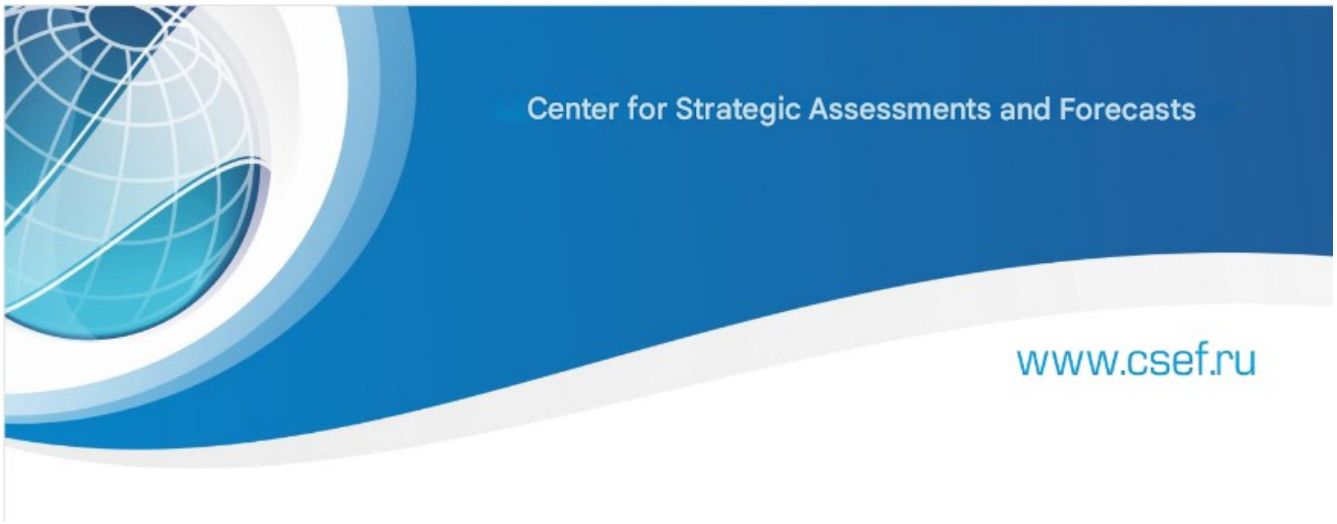


Oleg Valetsky

Foreign Mines in the Middle East and North Africa

Moscow 2016

Despite the signed convention and its protocols banning the use of anti-personnel mines, as well as various restrictions on the development and production of anti-tank mines, mines continue to be widely used in the Near and Middle East and North Africa, and without knowledge of their design, it is impossible to effectively conduct combat operations in these regions.

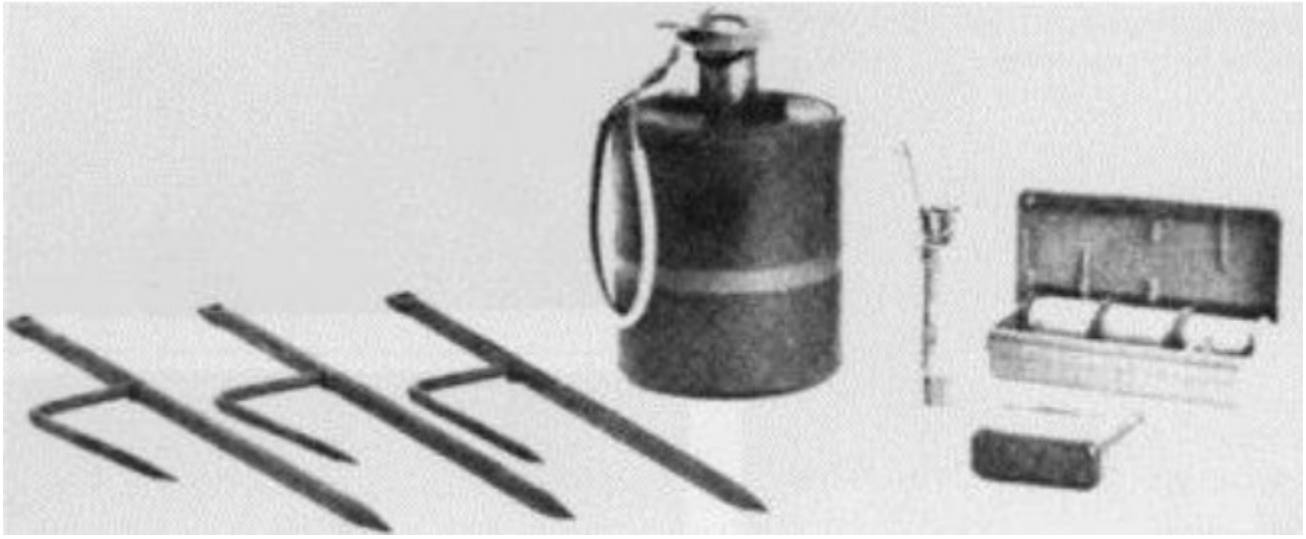
In the Middle East and North Africa, a large number of wars and armed conflicts have involved the use of a large number of mines developed by both NATO and Warsaw Pact countries, whose production was subsequently organized in the countries of these regions.

Israel has played and continues to play a major role in mine production, with its state-owned company, IMI, exporting hundreds of thousands of mines to South America, Asia, and Africa.

Israeli mines were not particularly sophisticated. For example, the No. 4 antipersonnel high-explosive pressure mine was similar to other mines of a similar type (the obsolete Soviet PMD-6), except that it had a plastic casing. This mine was copied in Iran and also produced in Egypt under the designation T-78.

Israeli antipersonnel high-explosive mine No. 4. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

Another Israeli anti-tank mine, the No. 6, was a direct copy of the Soviet TM-46 mine (although in addition to the No. 61 pressure fuse, it also had the No. 62A pin fuse). More modern were the anti-personnel fragmentation jumping mine, the No. 12 (its fuse was very similar to the American M-605 fuse of the M-16 mine).



Israeli antipersonnel bouncing fragmentation mine No. 12. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

Israel also produced the No. 10 anti-personnel high-explosive pressure mine.

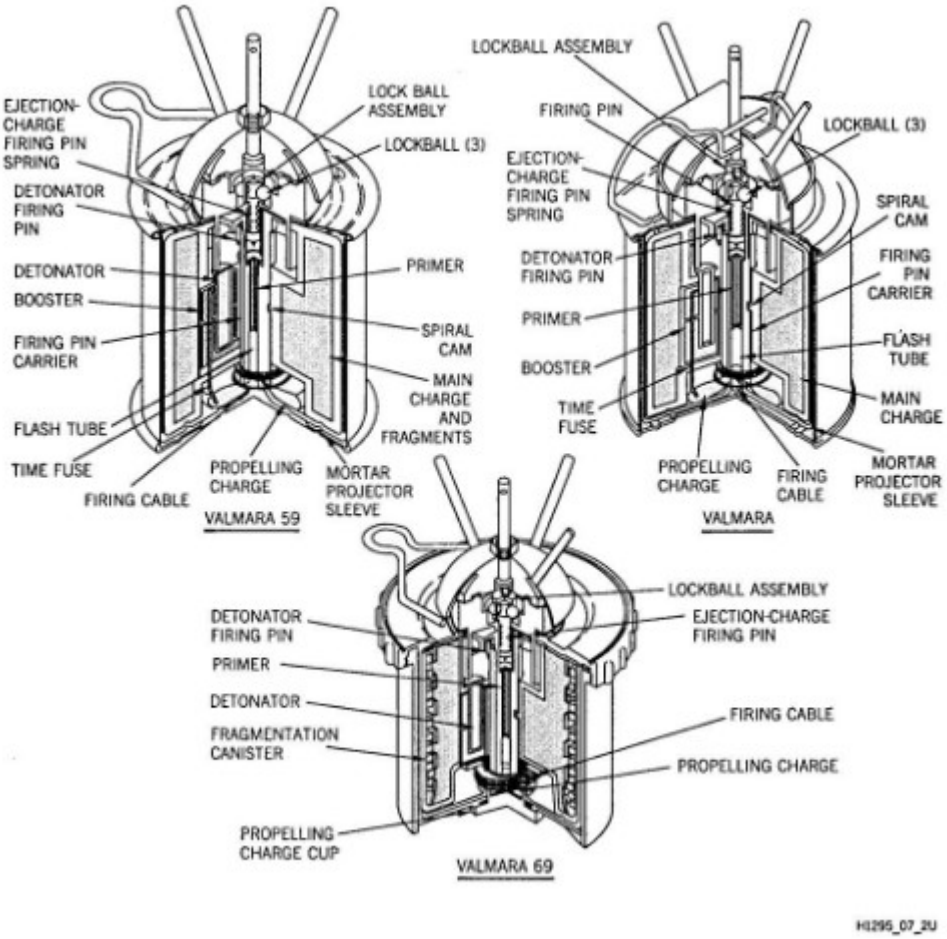
Israeli antipersonnel mine No. 10. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The Iran-Iraq War provided a major boost to mine sales. In the mid-1980s, Saddam Hussein's generals admitted they were unable to effectively stop Iranian infantry attacks, and so in 1987, Iraq, with the help of a loan from the United States, purchased more than 8 million Italian VS-50 high-explosive pressure antipersonnel mines, one million Valmara-69 antipersonnel explosive-fragmentation jumping mines, and several hundred thousand VS-1.6 antitank antitrack mines.

Photo of a Valmara-69 antipersonnel fragmentation mine.

Italian Valmara, Valmara V-59, and Valmara V-69 bounding fragmentation mines (total weight 3.2 kg, hexotol charge weight 420 grams) had fairly reliable double-action fuses. Valmara mines are also produced in South Africa and Singapore (No. 69 Mk1 and SPM-2).

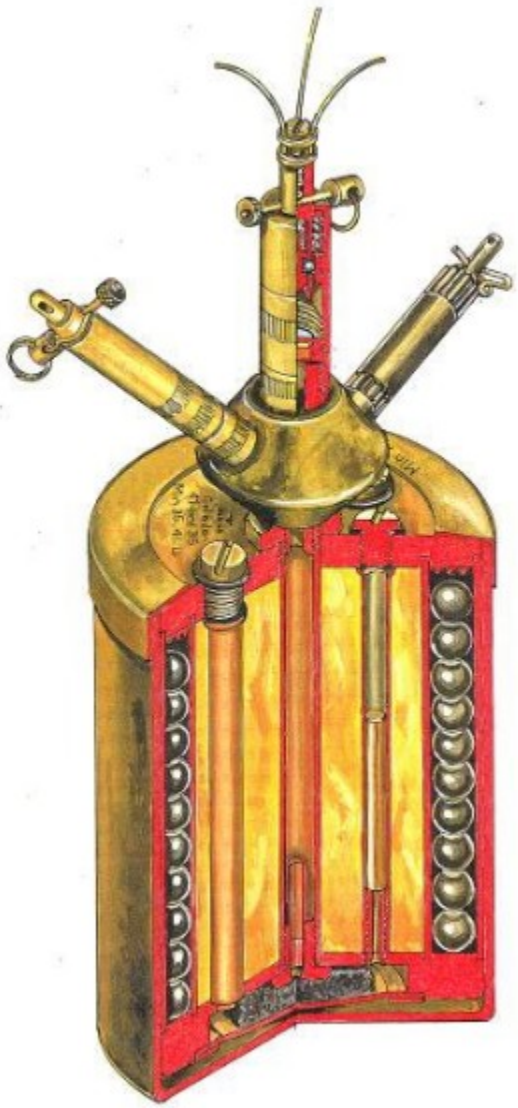
The pressure cap of these mines has a large effective area of the target pressure sensor due to four spaced pins, which, with holes in the upper part, can also be used to attach four tripwires (each 15 meters long).



Cross-section of Italian fragmentation jumping mines with circular effects Valmara, Valmara V-59, and Valmara V-69. Source: ORDATA-2 reference book

An interesting feature of the Valmara fuse design is that tilting the cap, caused by pressure on the inclined pins or tension on the wires attached to the inclined pins, compresses the striker spring and lifts the sleeve holding the safety balls, causing the balls to roll out into the empty cavity and release the striker. However, pressing the fuse cap at a right angle does not trigger the fuse, as the safety balls do not fall out. It is also worth noting the relatively simple and reliable horseshoe-shaped safety clip, which securely holds the cap in place.

After the war, the French copied the German S.Mi. 35 anti-personnel fragmentation mine under the name Mi-AP-MB-51, including its fuse, the base of which could accommodate both a tripwire fuse and a pressure fuse, as well as an electric igniter.

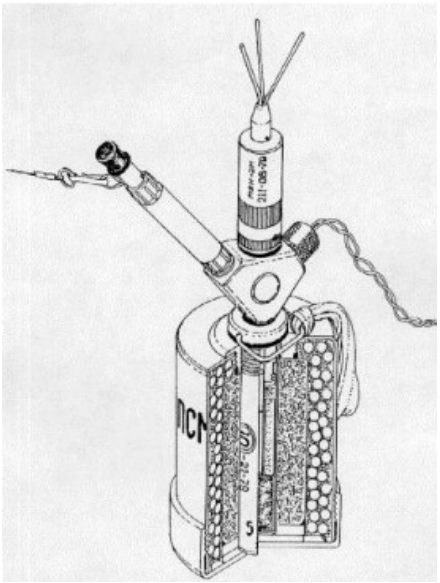


Wehrmacht S.Mi. 35 anti-personnel fragmentation jumping mine. .Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

However, the Mi-AP-MB-51 mine had an internal fuse, not a powder delay device, but a tripwire mechanism. The mine had a tripwire-activated fuse with an inclined pin to which a tripwire was attached.

Mi-AP-MB-51 antipersonnel fragmentation jumping mine. Photo from Humanitarian Demining website www.humanitarian-demining.com

A similar triple-headed choke, like that of the S.Mi. 35, was also used in the Bulgarian post-war PSM-1 mine, exported to countries in the Middle East and North Africa.



Sectional view of a PSM-1 antipersonnel fragmentation mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

In it, the propellant powder charge (5.5 g of powder) was housed together with the internal fuse in a single zinc-alloy pyrotechnic cartridge housing. The flame booster was simultaneously supplied from the igniter cap and onto the internal fuse's retarder and through oblique channels through the cavity between the walls of the detonator body and the fuse to the powder charge located at the bottom of the latter.

Training antipersonnel explosive-fragmentation mine PSM-1. Photo by Nayden Iliev

The Bulgarian PSM-1 mine (total weight 2.69 kg, explosive weight 165 g) has a triple-action trigger, copied from the triple-action trigger found on the German S.Mi. 35 mine from World War II, allowing for the simultaneous installation of three different types of fuses. This feature complicates handling of the mine, but increases its effectiveness.

After the defeat of Iraq in 2003, the Iraqi army's vast stockpiles of mines were left uncontrolled. These mines were produced by Belgium (PRB M3/A1 anti-tank high-explosive mine, PRB M409 anti-personnel high-explosive mine), China (Type 72 anti-personnel high-explosive pressure mine, Type 72 anti-tank anti-track mine), Israel (No. 4 anti-personnel high-explosive mine), and Italy (SB-33, TS-50, VS-50, VAR/40 anti-personnel high-explosive mines, P-25 anti-personnel fragmentation mine, V-69 anti-personnel fragmentation mine, VS-1.6 and VS-2.2 anti-tank anti-track mines), USSR (PMD-6 and PMN high-explosive anti-personnel mines, POMZ-2 and POMZ-2M fragmentation anti-personnel

mines, TM-46, TM-57, TM-62M anti-tank anti-track mines), USA (M-2 anti-personnel fragmentation bounce mine, M-3 anti-personnel fragmentation mine, M-14 anti-personnel high-explosive push mine, M-16 anti-personnel fragmentation mine, M-18A1 directional fragmentation anti-personnel mine, anti-tank anti-track mines M-15 and M-19 mines), Yugoslavia (PROM-1 anti-personnel bounding fragmentation mine).

A similar situation developed after 2011 in Libya, where large stockpiles of mines, in particular Brazilian TAB-1 anti-personnel high-explosive mines, Belgian M3 and M3A1 anti-tank anti-track mines, as well as Belgian NR 413 (stake mine), NR 109 (stake mine), and NR 442 (bounding) mines, Chinese Type 72 SP anti-tank mines (a modification of the Soviet TM-46), Yugoslav TMA-5 anti-tank anti-track mines, and Czechoslovakian Mi-Ba-III PT anti-tank anti-track mines were left uncontrolled by the Libyan Army.

A similar situation exists in Syria, where the Syrian army warehouses primarily contained Soviet-era mines of the PMN-2, OZM-72, TM-57, and TM-62 types.

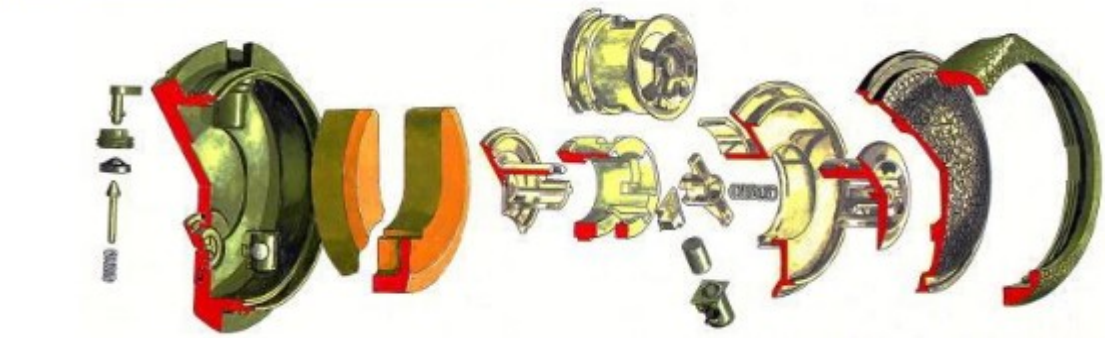
At the same time, a large number of Iranian-made mines were used in both Iraq and Syria.

Iran's production capacity has enabled it to produce the following mines: the YM-I antipersonnel high-explosive pressure mine (Italian TS-50), the YM-II (SB-81) antitank track mine, the Chinese YM-III (Type 72) antitank track mine, and the copied Israeli No. 4 antipersonnel high-explosive pressure mine, allowing it to meet the needs of all its potential allies. Iran officially suspended production of antipersonnel mines at the end of the war with Iraq, but it appears to be continuing, as evidenced by the discovery of YM-1 mines from Afghanistan and Syria in the ongoing wars there.

As for the countries that developed mines used in the Middle East wars, Italy stood out, with its mines widely distributed around the world. The Italian company BPD sold mine production licenses to Spain (EXPAL SA), Portugal, Greece, the Netherlands, Argentina, and Iran.

Photo of an SB-33 antipersonnel high-explosive mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

Thus, its SB-33 high-explosive anti-personnel mine (SB-33 AR with an anti-handling device) was produced in Greece (EM-20), in Portugal (M-412), and in Spain (P-5).



Cross-section of an SB-33 antipersonnel high-explosive mine. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood

The SB-81 anti-tank, anti-track mine, developed in Italy, was also produced in Spain (under the name Expal SB-81), Portugal (under the name M-453), and Iran (under the name YM-II).

An Iranian-produced anti-tank anti-track mine, designated YM-II. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

Valsella sold licenses to Singapore and South Africa. For example, the Valmara 69 antipersonnel fragmentation mine was manufactured in Singapore (SPM-2) and South Africa. The VS-50 high-explosive pressure-operated antipersonnel mine (VS-50 EO3 antipersonnel mine with an antihandling device) was also produced in Singapore under the designation SPM-1.

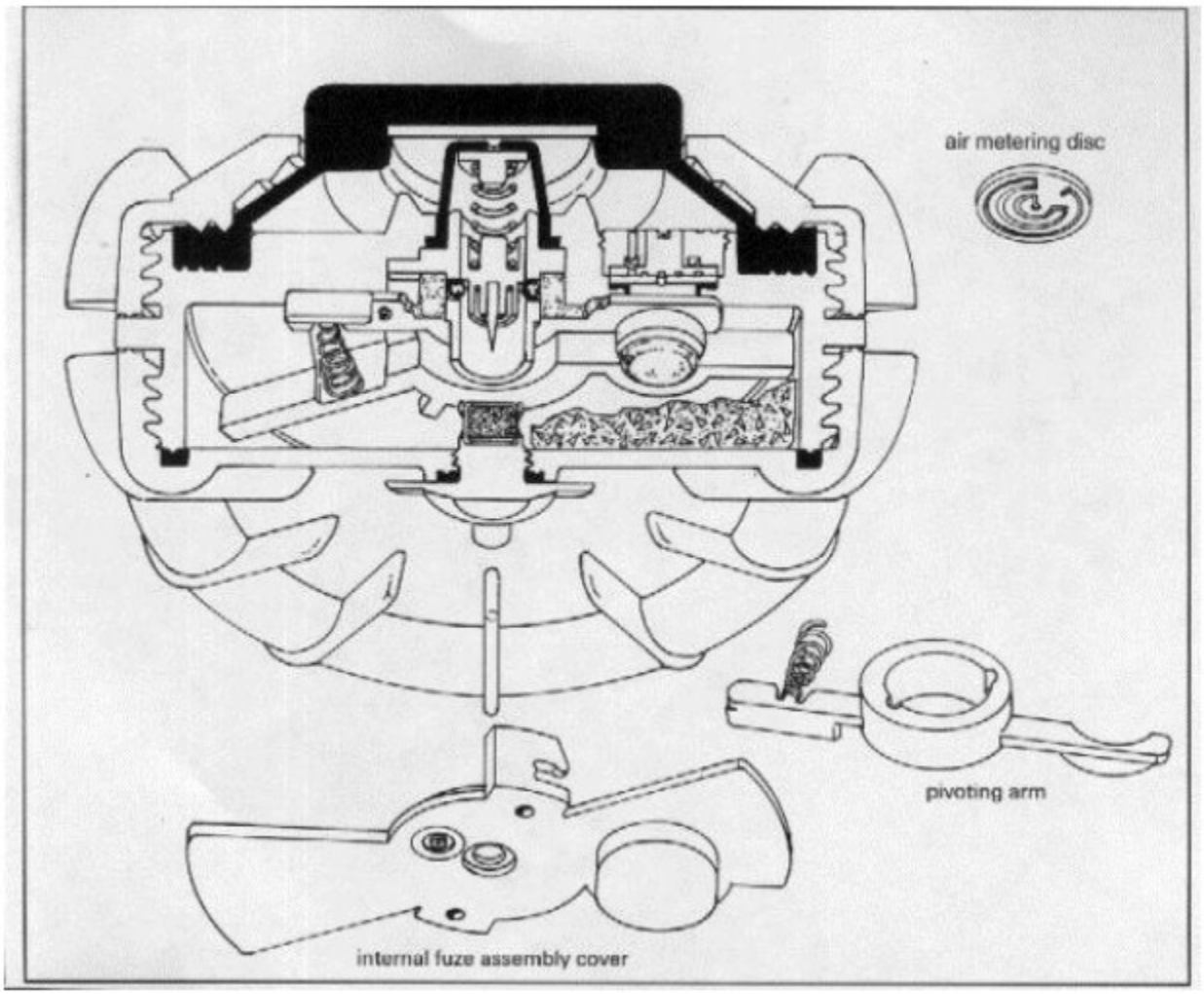
Italian mines can be found practically all over the world, and they were widely used by mujaheddin forces in Afghanistan, first against the Soviet and Afghan armies, and then against each other.

A distinctive feature of Italian mines is the presence of a cavity under the pressure cap. When pressure is applied to the cap, this cavity slows the transfer of pressure to the fuse head, increasing the mine's resistance to the shock wave of demining charges. The shock wave creates very high pressure, but only for a short time, preventing the mine from detonating. The pressure exerted by the victim's foot on the mine cap, however, is more sustained. This pneumatic fuse safety system (shock-resistant fuze) provided protection against remote-controlled explosive devices.

A similar system is used in the Italian TS-50 anti-personnel high-explosive mine (weight 186 g, width 90 mm, height 45 mm, charge weight (phlegmatized hexogen) 50 g).

An Italian TS-50 antipersonnel mine, produced in Iran under the designation YM-I. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The mine is triggered by a pneumatic-mechanical fuse. Air from the cavity flows through calibrated holes into a rubber bulb, which, as it expands, rotates a rocker arm horizontally around its axis. One end of the rocker arm rests against this bulk, while the other end, with a spring, moves the primer under the striker. When the bulb, expanding, overcomes the resistance of the spring and turns the rocker arm fully, the safety balls fall out of the corresponding slots in the sleeve into the slotted central part of the bulk.



Cross-section of an Italian TS-50 high-explosive anti-personnel mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King)

Until this point, these balls had held the striker, whose spring was compressed by the pressure cap. The released striker strikes the cap of the M41 detonator, which is inserted into the mine through the bottom hole.

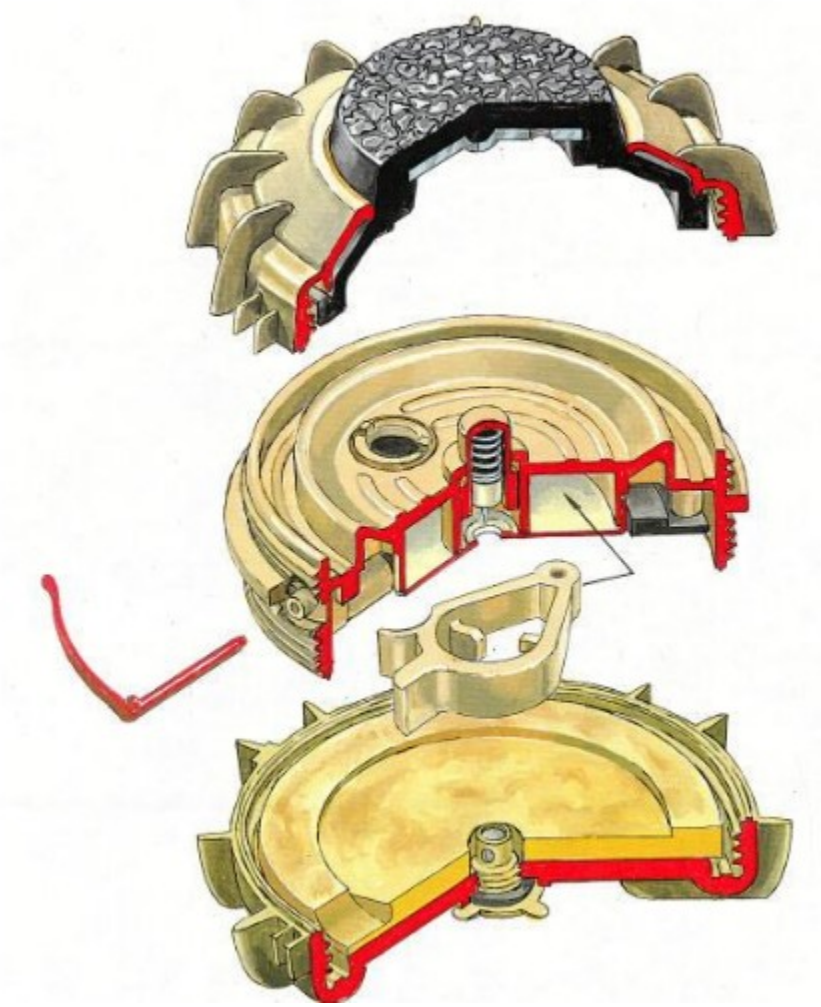
The VS-50 mine, while externally very similar, differs from the TS-50 in its design. They can be distinguished externally by the presence of a safety stop on the side of the VS-50's casing, while the TS-50 has a safety cap covering the pressure cap.

Italian VS-50 high-explosive antipersonnel mine. Photo by Nayden Iliev

This mine, weighing 185 grams and containing a 43-gram charge (hexogen), has three sections: an upper section with a pressure cap, a lower section through which the M41 detonator is installed, and a middle section onto which the remaining sections are screwed.

Photo from inside an Italian VS-50 high-explosive antipersonnel mine. Photo by Nayden Iliev.

The central section contains the firing mechanism and the explosive charge. The firing mechanism, like the TS-50, contains a cartridge holding the rocker arm, but it is shaped slightly differently. It has an internal cavity through which a sleeve extends. The sleeve houses a spring and a striker. The sleeve is locked by a tooth on the rocker arm. A safety catch blocks the rocker arm. After removing it and pressing on the mine's cover, the spring is compressed and the cartridge fills with air. The cartridge presses on the rocker arm, causing the rocker arm to move aside and release the striker.



Sectional view of an Italian VS-50 high-explosive antipersonnel mine. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

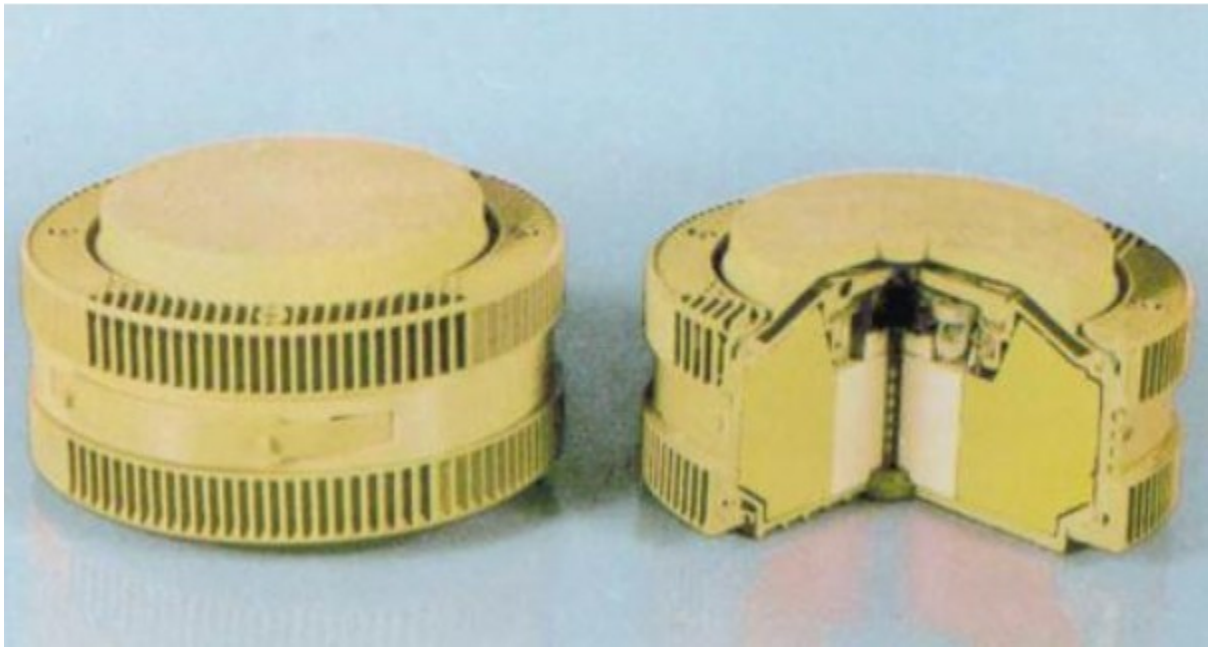
It's interesting to note that the Italian VS-50 and TS-50 mines, whose design offers maximum resistance to explosive demining agents, are relatively easy to defuse—just unscrew the detonator cap and pull it out.

The underside of an Italian anti-personnel high-explosive mine VS-50. Photo by Ilie Nayden

There is also a VS-50E3 electronic booby trap, similar in appearance to the VS-50, with a mercury-based, tilting anti-removal device.

Tecnovar sold mine production licenses to Iran and Egypt. The TS-50 high-explosive pressure antipersonnel mine was produced in Iran (YM-I) and Egypt (T-79).

Tecnovar also sold licenses for the TC-2.4 anti-tank anti-track mine to Egypt, where they were produced under the designation M-80, and an improved version, the M-81, was developed.

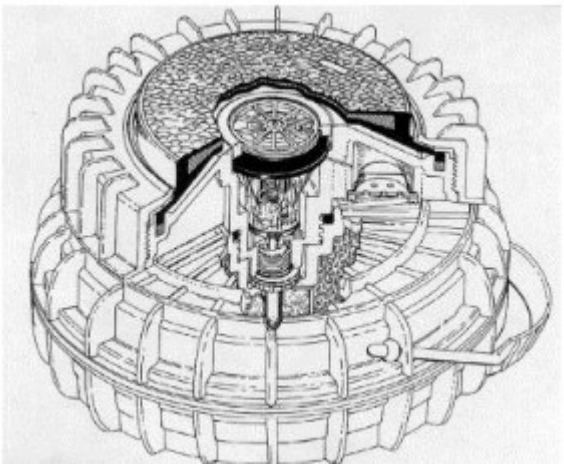


Egyptian-made M-80 anti-tank anti-track mines (TC-2.4 copy). Photo from Jane's Mines and Mine Clearance 1999- 00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King)

The TS-2.4 mine's integral detonator, manufactured by the Italian company Technovar Italiana SpA, has a unique design that is resistant to explosive demining charges.

In this mine, the target's impact is transmitted to the striker by air passing from the upper air cavity to the lower one. However, the striker, which is acted upon by the diaphragm, has not only a pressure spring but also two locking levers, the rear ends of which rest against a flexible inflatable bladder. This bladder has a safety counterspring and a calibrated opening connecting the upper and lower cavities. Air passing through this opening fills the bladder, which, as it fills with air, overcomes the resistance of the counterspring, rotating the locking levers and releases the striker. The fuse, as in mines made by Valsella Meccanotecnica SpA, is installed through a hole in the bottom of this mine. The mine weighs 3.6 kg, the hexotol charge weighs 2.4 kg.

During the Iran-Iraq War of the 1980s and the war in Afghanistan in 1979-89, the TS/3.6 and TS/6 anti-tank anti-track mines from the Italian company Technovar Italiana SpA were widely used.

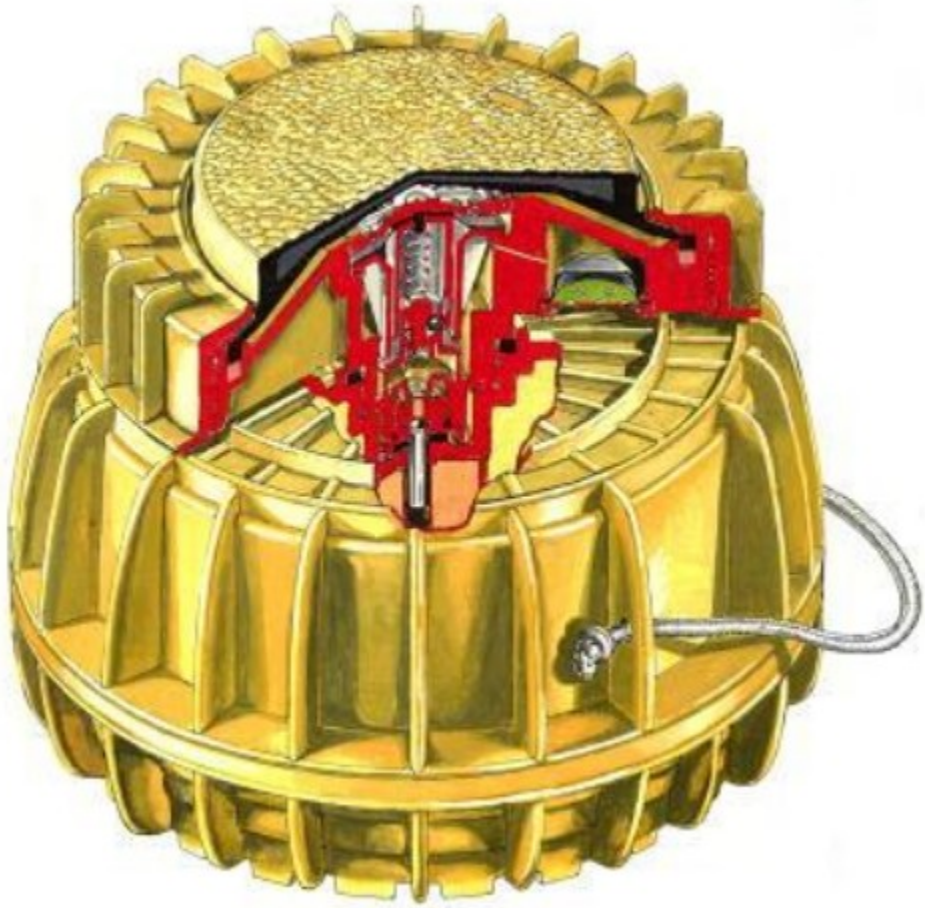


Cross-section of an Italian anti-tank anti-track mine TS/3.6. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The TS/3.6 and TS/6 mines differ only in their total weight, charge weight, and the height of the upper half of the casing. The total weight is 6.8 and 9.6 kg, respectively, while the hexotol charge is 3.6 and 6 kg.

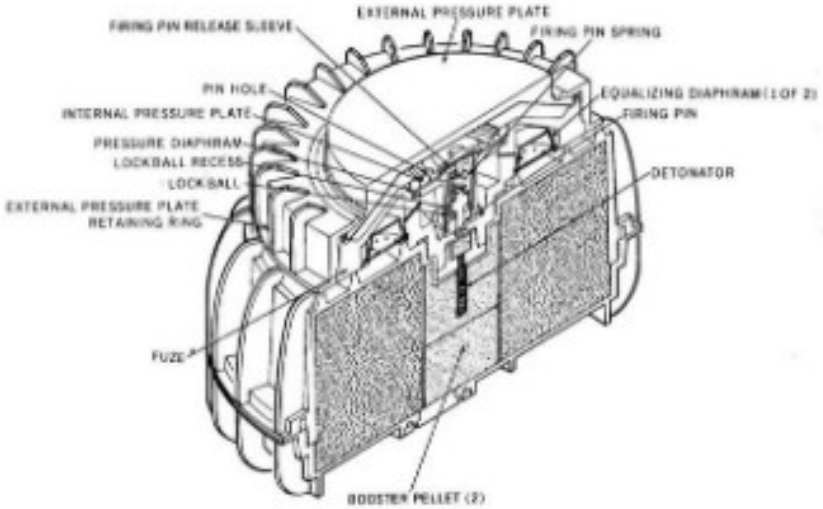
Photo of the Italian TS/6 anti-tank anti-track mine

These mines are cylindrical rather than disc-shaped, and have a plastic casing reinforced with vertical ribs. The casing consists of two halves screwed together.



Sectional view of an Italian anti-tank anti-track mine TS/6. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

An integral pressure-type fuse is screwed onto the top of the mine. The bottom of the upper half of the fuse has two compensators with rubber sockets, sealed with removable plugs. These compensators serve to equalize the pressure in the fuse when the temperature rises. The fuse is screwed into the upper half before the mine is installed, also from the bottom.



Sectional view of an Italian anti-tank anti-track mine TS/6. Source: ORDATA-2 reference book

The integral fuse of these two mines is similar in design to the SH-160 fuse. Pressing the pressure cap causes air to flow from the upper air chamber to the lower chamber through calibrated holes in the fuse cap. A diaphragm located in the lower air chamber bends and presses on a sliding bushing. The bushing compresses the mainspring within it and simultaneously presses on the striker, which is held in place by safety balls. Once the grooves in the bushing align with the safety balls, the balls roll out and release the striker.

There were TSE/3.6 and TSE/6 modifications with fuses that had an electronic system for bringing the fuses into combat position and back.

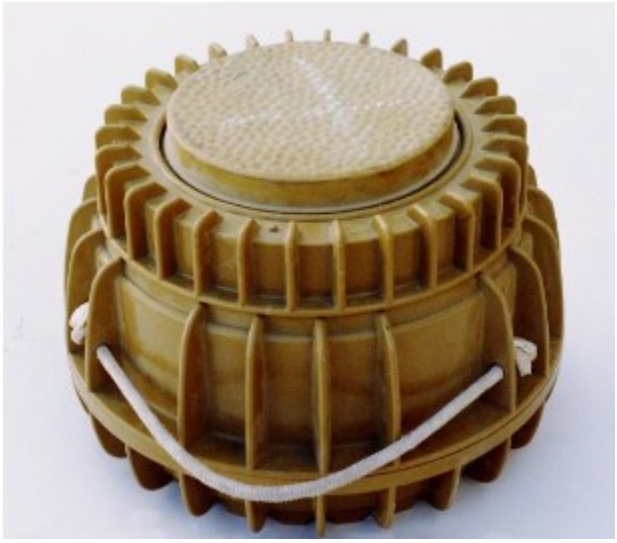
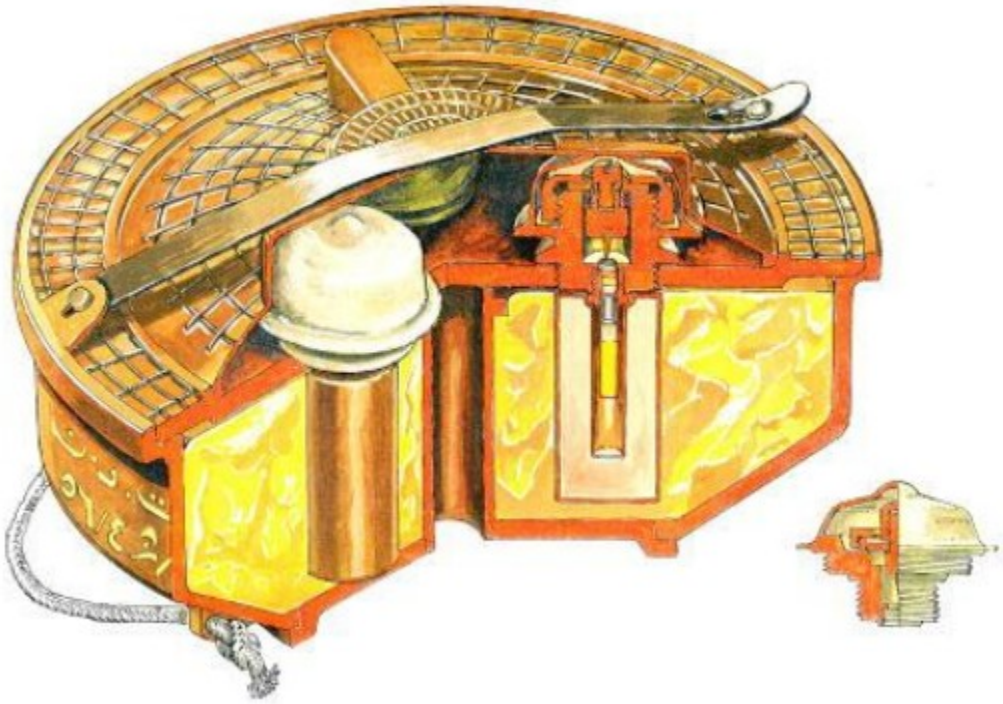


Photo of an Italian TSE/6 anti-tank anti-track mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

In the 1960s-80s, Italy had the largest selection of anti-tank, anti-track mines and sold a large number of them, as well as production licenses, to several countries in the Middle East (primarily Iran, Iraq, and Egypt).

One of the first such mines was the SACI 54 mine, which came in three versions, differing in charge weight: SACI 54/5 (weight 6.23 kg, charge 5 kg), SACI 54/7 (weight 8.23 kg, charge 7 kg), SACI 54/9 (weight 10.23 kg, charge 9 kg).



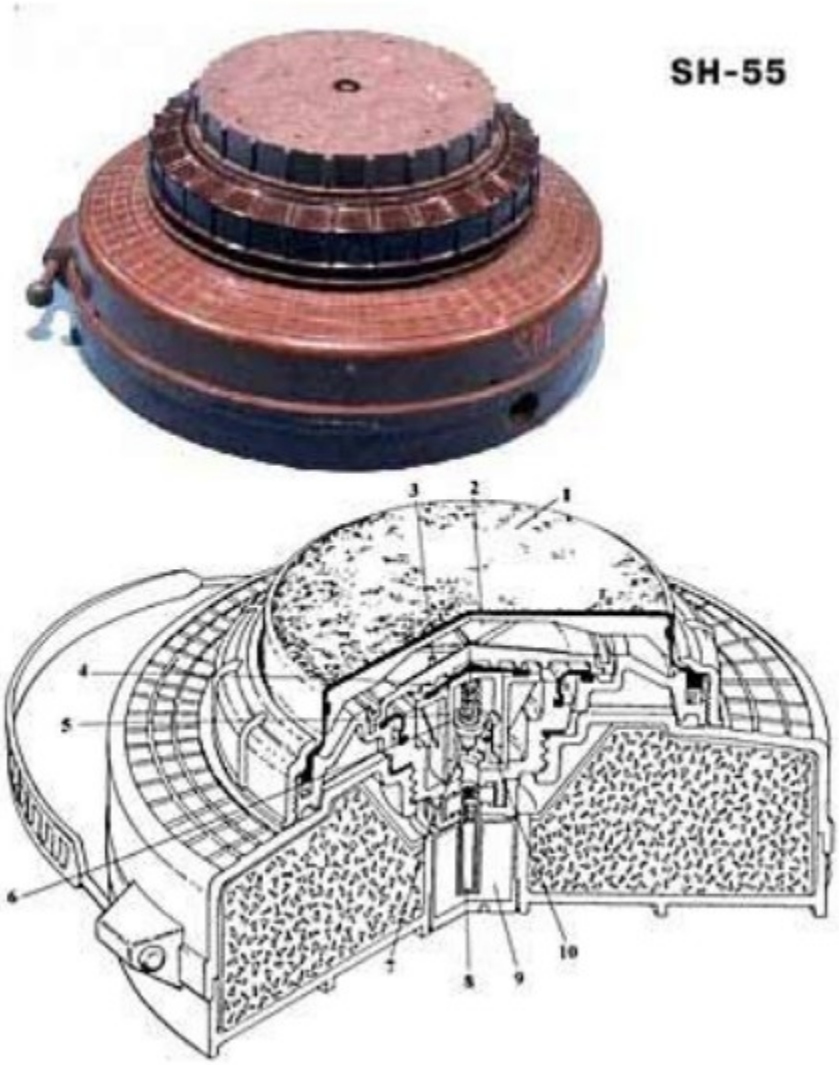
The SACI 54 antitank antitrack mine, produced under Italian license in Egypt. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

This mine had a bakelite casing and three pressure-operated mechanical fuzes under a common AC 52 cover with a spring-loaded striker and a breaking disk. A modification of this fuse, designated ACS 52, exists, which functions as a booby trap and is triggered by an attempt to unscrew the mine's cover.

A modification of the SACI 54/7 mine, also produced in Egypt and Cuba, had a significant drawback: the pressure cap was made not of Bakelite, but of thermoplastic plastic, which deformed at high temperatures, leading to frequent mine failures.

Later, the SACI 54 mine was used as the basis for the SACI IMAS mine, modifications 5, 7, and 10, which also had a bakelite body and an unscrewing lid, under which were placed the AC-1 or AC-2 fuses, which had a multiplier device (first, second, third, or fourth press for activation).

The SH-55 anti-tank, anti-track mine, developed and manufactured by Valsella Meccanotecnica SpA, and its FD modification (weight 7.3 kg, charge 5.5 kg of hexotol), had a disc-shaped plastic body, typical of Italian mines, with a socket for the primary and a socket for an additional anti-handling fuse. Initially, this mine was equipped with the SH 160 pneumatic fuse.



SH-55 antitank antitrack mine. Source: Yu.G. Veremeeva

This fuse, into which the OTO fuse was screwed, had a cavity (the upper air chamber) under the pressure cap, connected by a calibrated hole to a lower air chamber containing a diaphragm. Under the diaphragm was a plastic striker, which, under the pressure of the diaphragm, which deflected from the air and passed from the upper to the lower cavity, entered a shear bushing with a striker. The latter, in turn, struck the OTO fuse. This multi-stage pneumatic system was designed to ensure the mine's detonation under prolonged load (tank tracks, vehicle wheels), but to prevent detonation under the shock wave of explosive demining equipment.

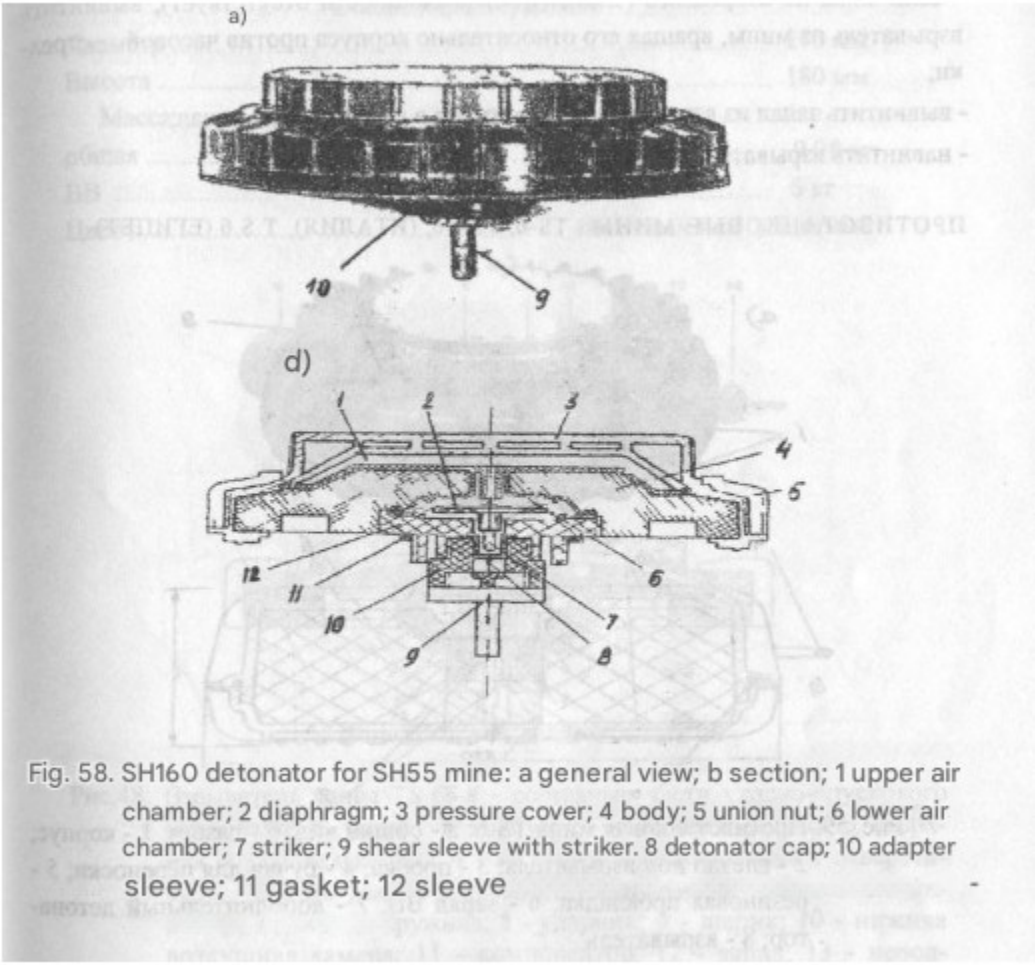


Fig. 58. SH160 detonator for SH55 mine: a general view; b section; 1 upper air chamber; 2 diaphragm; 3 pressure cover; 4 body; 5 union nut; 6 lower air chamber; 7 striker; 9 shear sleeve with striker. 8 detonator cap; 10 adapter sleeve; 11 gasket; 12 sleeve

Pneumatic fuse SH 160

Later, a more advanced pneumatic fuse, the VS-N, was developed. In this fuse, a diaphragm pressed on a movable sleeve, which compressed a mainspring located within it, with a striker mounted underneath.

The striker was held in place by safety balls in the cup until the descending sleeve's grooves aligned with them and the balls, rolling out into the grooves, released the striker.

Several other detonators were developed for this mine. These include the VS-N-TLC with the ability to remotely switch the detonator from transport to combat position and back; the VS-N-EL2 with an anti-handling device; and the VS-N/AR-AN with an anti-handling and self-neutralizing device (128-day operational life).

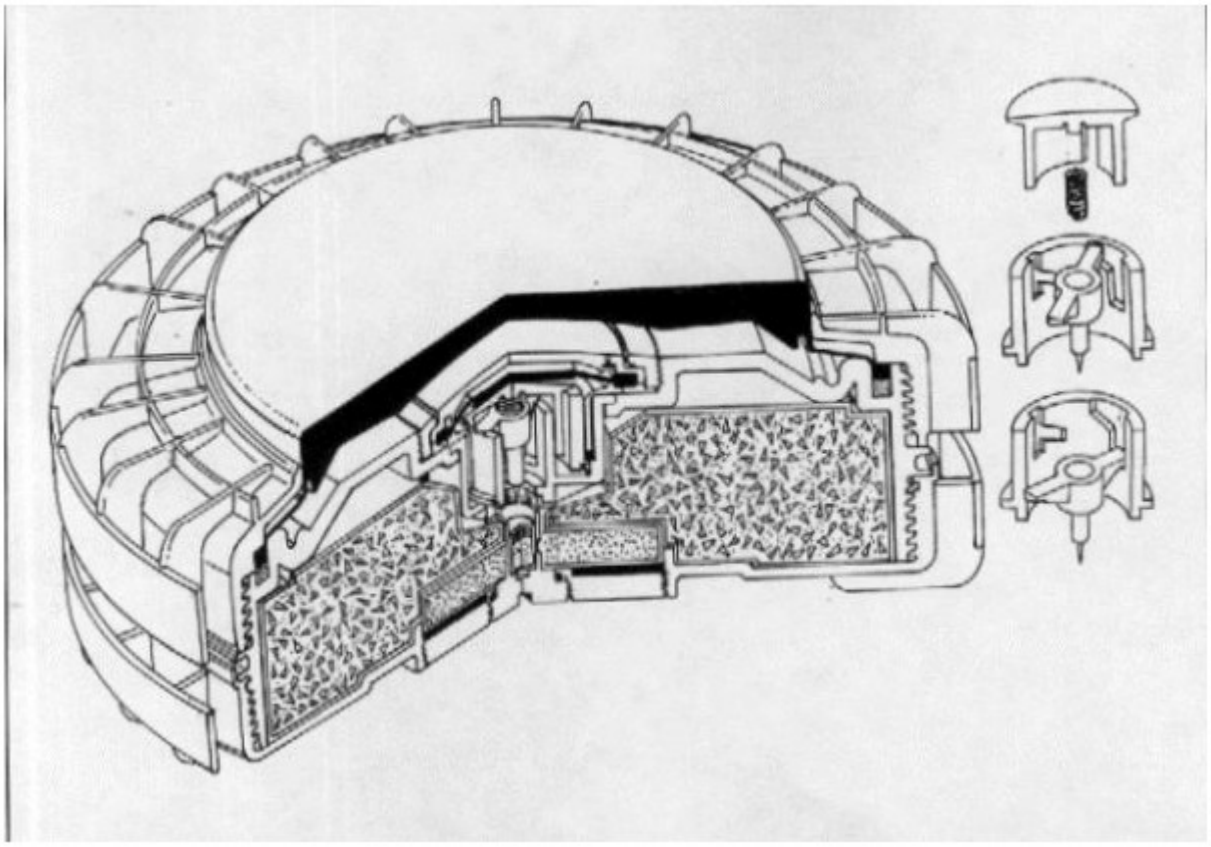
These fuses were also used in a number of later mines developed by Valsella Meccanotecnica SpA - VS-1.6, VS-2.2, VS-3.6, VS-6.0, VS-9.0.

Anti-tank anti-track mines VS-1.6, VS-2.2, VS-3.6. Photo by Yu. G. Veremeev

All these mines had a disc-shaped body with reinforcing ribs and a protruding, flat pressure cap. They differed slightly in appearance, but mostly in the weight of the charge. They were loaded with hexotol, a mixture of TNT and hexogen, also designated RDX-TNT or "Composition B." The charge weight is indicated in the numerical portion of the mine's designation.

The VS-1.6 mine, with a 1.6 kg hexotol charge, was an exception. Its casing design was unremarkable, but its integral fuse had a cup with shaped grooves (oblique at the top, straight at the bottom) and a tooth holding the bushing with the striker. The bushing has shaped tabs, located on the oblique edges of the grooves, and this tooth prevents the bushing from moving downward. A spring is installed in the bushing, and on top is a movable pressure head. Above the pressure head is a

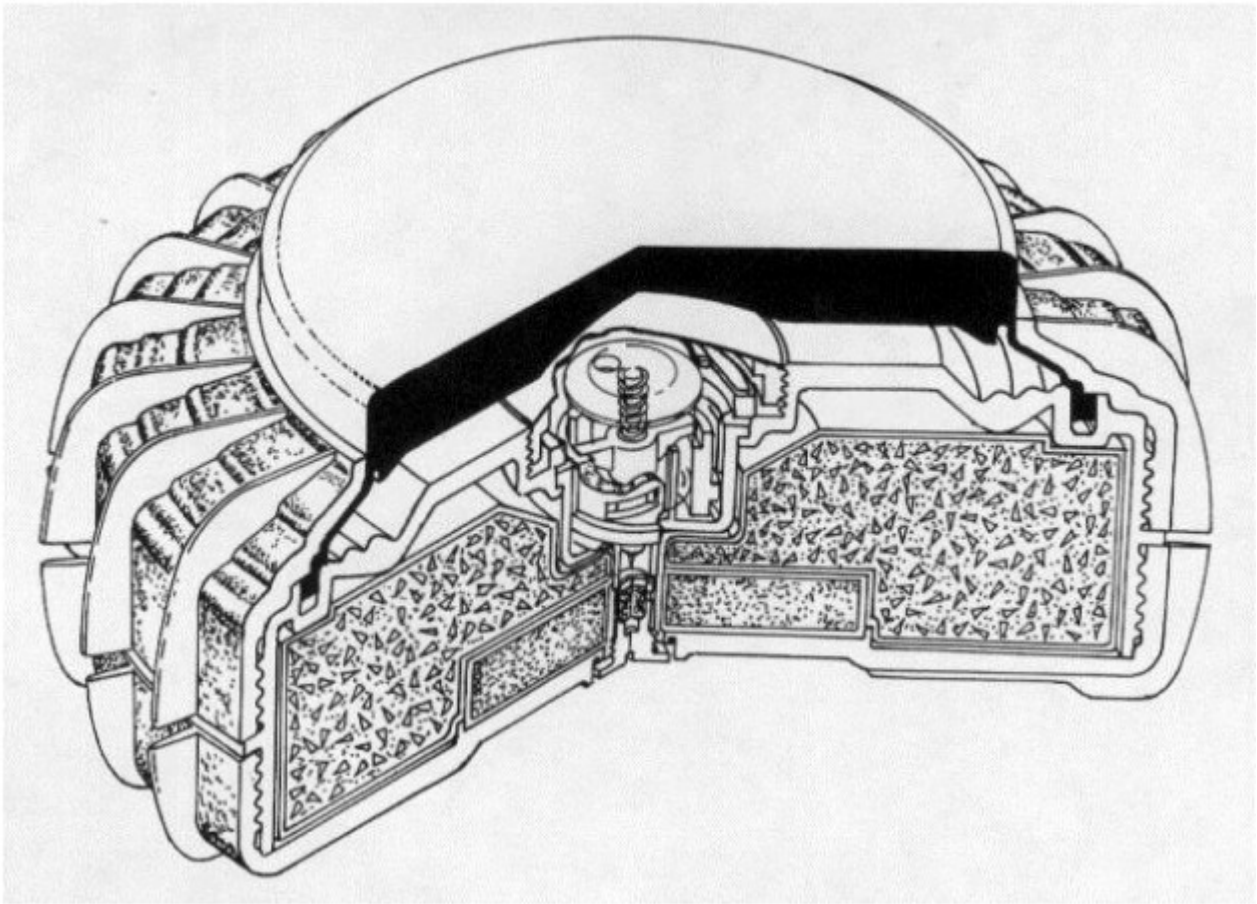
diaphragm, and above it, there is a small channel in the fuse plug leading to the upper air cavity. Above this cavity is the mine's pressure cap.



Cross-section of a VS-1.6 anti-tank anti-track mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The impact on the cap causes air to flow through the channel and the diaphragm to deflect, causing the mainspring to be compressed by the head, the sleeve to rotate along a curve, disengage from the tooth, and the legs, along with the sleeve and striker, to exit the vertical grooves. In addition to the basic VS-1.6 mine, there was a modification, the VS-1.6 E1, with an unhandling and self-destruct feature.

A similar fuse design is found in the fuse of the SB-81 anti-track mine, developed and manufactured by another Italian company, MISAR.



Cross-section of an Italian SB-81 anti-tank anti-track mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

This mine is also produced in Spain, Portugal, and Iran. This mine has a slightly more powerful charge than the VS-1.6, weighing 2.2 kg. There is also an electronic modification of this mine, the SB-81-AR/AN, with self-destruct and non-handling features. This mine weighs 3.3 kg, and the charge (a mixture of TNT, RDX, and HMX) weighs 2.2 kg. All modifications of the SB-81 and VS-1.6 mines have an M-41 fuse, installed through the bottom hole.

The PM-60 (K-1) anti-tank, anti-track, high-explosive mine, produced in the former GDR, also had a plastic casing. It weighed 11.4 kg, contained 7.5 kg of TNT, was 323 mm wide, and 117 mm high.

The PM-60 anti-tank anti-track mine, developed in the former East Germany. Photo from Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

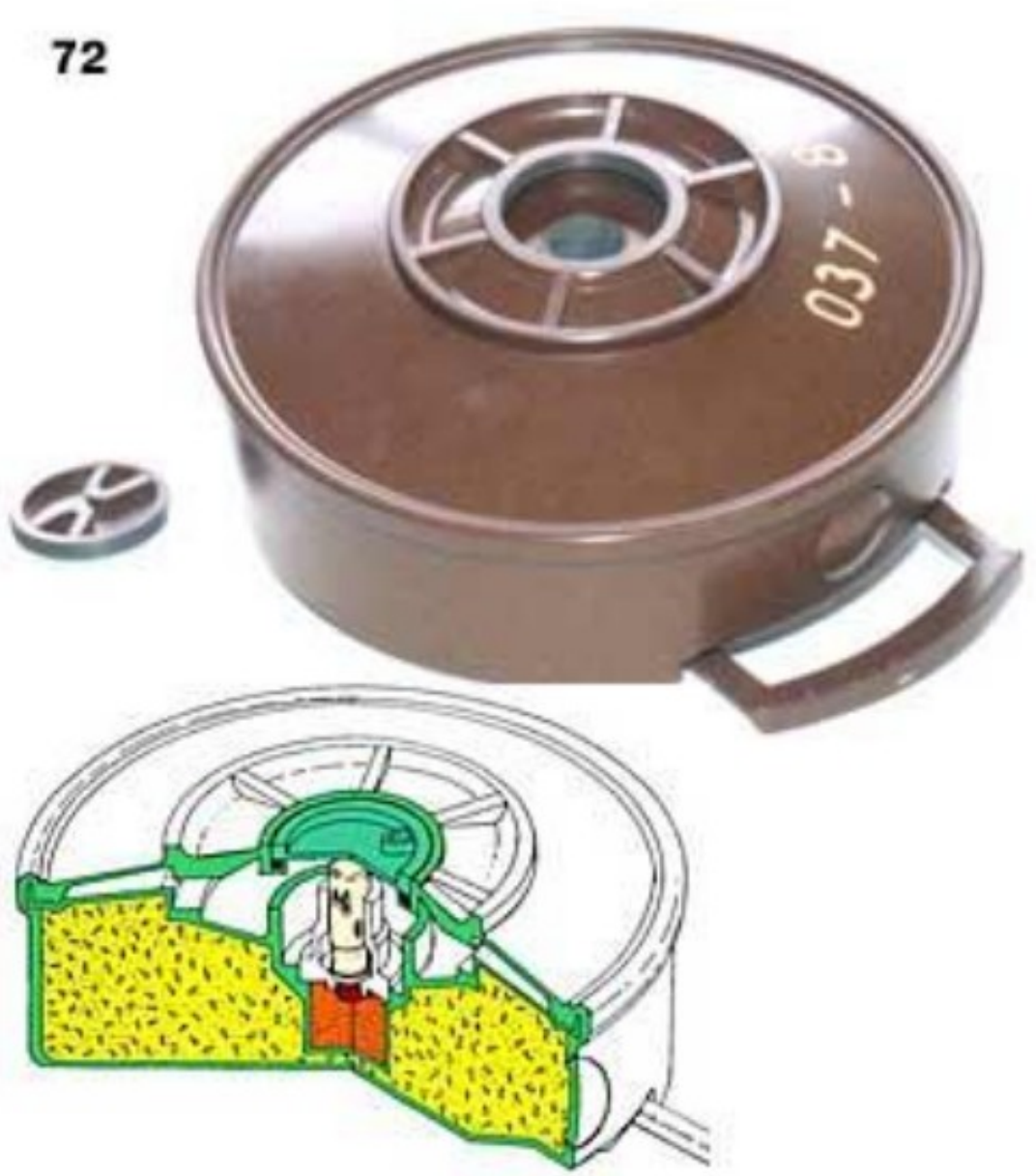
Its rounded body, consisting of two halves, was connected in a circle with cotter pins. The mechanical fuse, together with the detonator capsule, is installed in an auxiliary detonator, located in a separate chamber and is inserted through a hole in the bottom center of the mine. The detonator's pressure rod is secured through the top of the housing by a safety catch shaped like a fork at the end and a handle on the outside of the housing. The mine is armed by pulling the safety catch. The mine has an auxiliary detonator, into which a antihandling device or tripwire fuse can be installed through a hole in the bottom of the mine.

Cross-section of a PM-60 anti-tank anti-track mine. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

However, the Italians were not the only ones to develop mines with fuses protected from ammunition explosions, thereby reducing the destructive power of enemy remote mine-clearing devices.

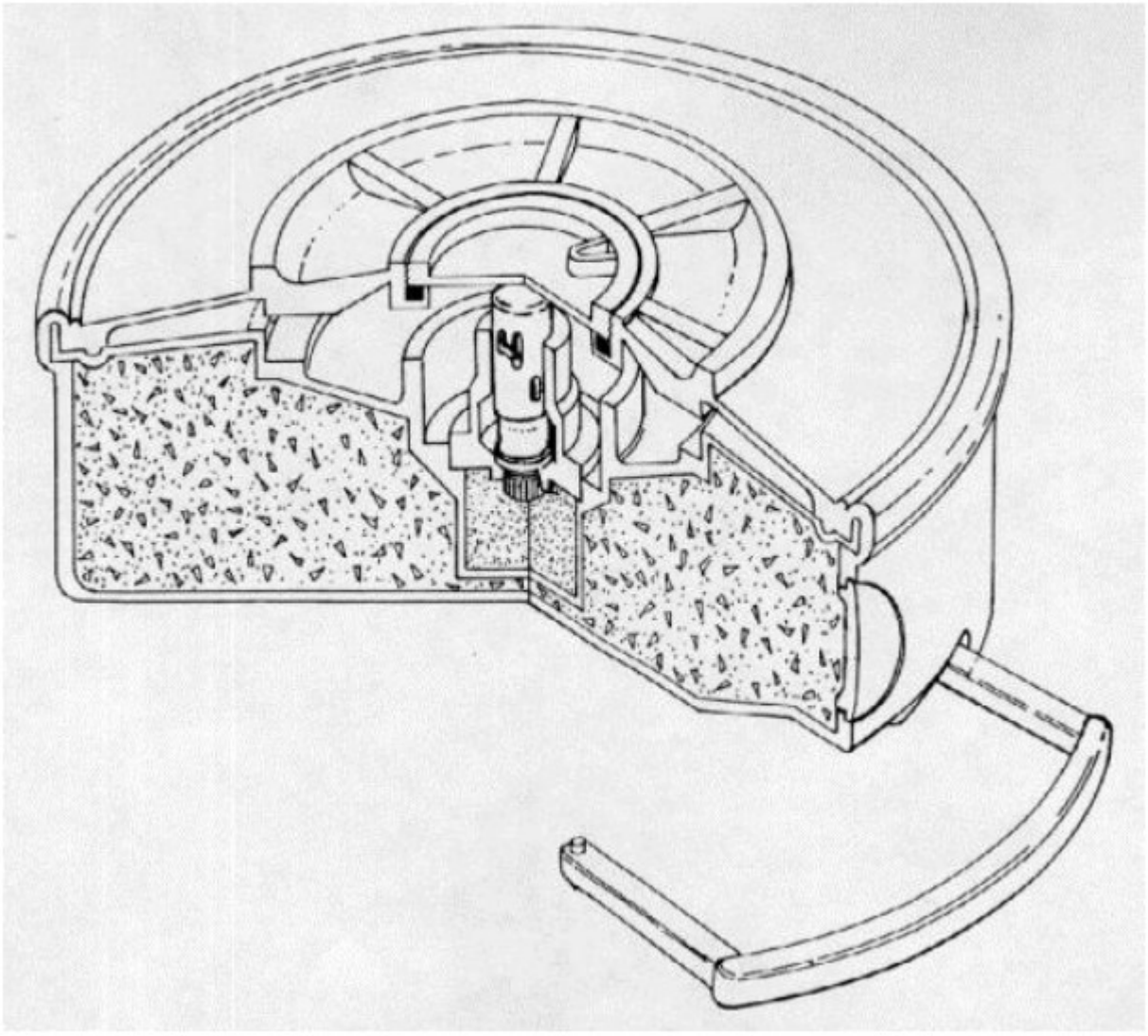
China also followed the path of using pneumomechanical and pneumatic detonation principles, creating the Type 72 anti-tank anti-track mine with a plastic casing and a charge weight of 5.4 kg of hexotol (50/50) for a total weight of 6.5 kg.

This mine was also produced in South Africa and Iran (under the designation YM-III) and was widely used in wars in southern Africa and the Middle East.



The Chinese Type 72 anti-tank anti-track mine, produced in Iran under the designation YM-III. Source: Yu. G. Veremeev

In the center of the pressure cap is a screw-on lid for the fuse socket. A disc spring is located in the middle of the lid, which, when pressed, transfers pressure to the fuse head.



A cross-section of a Chinese Type 72 anti-tank, anti-track mine, produced in Iran under the designation YM-III. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The fuse has a classic design with a spring-loaded striker held in place by safety balls in a sleeve. The sleeve has holes cut into it, but they are diagonally opposite the balls. When the fuse head is pressed, the sleeve, as it descends, simultaneously rotates its outer edges along diagonal grooves in the sleeve until the balls align with the holes in the sleeve and release the striker. If the mine's cover is struck sharply, as occurs due to the shock wave from explosive mine-clearing equipment, the sleeve doesn't have time to rotate as it descends and is stopped by the ball. The safety balls remain in place, blocking the striker, and no explosion occurs.

The fuse of the Chinese Type 72 anti-tank anti-track mine. Source: Yu. G. Veremeev

After the pressure in the shock wave front drops, the disc spring returns to its original position, bending outward, and the bushing, under the pressure of the striker spring, returns to its previous position.

There are three modifications of this mine: Type 69, Type 72A, and Type 81, although due to the traditional confusion in naming conventions for Chinese weapons systems, these may refer to the different types of fuses used in this mine (Type 69 is a double-pulse, Type 72 and 81 are single-pulse, and Type 72A is pneumatic). The fuse design and the presence of an air gap between the pressure cap and the fuse allow this mine to be deployed by remote-detonation systems.

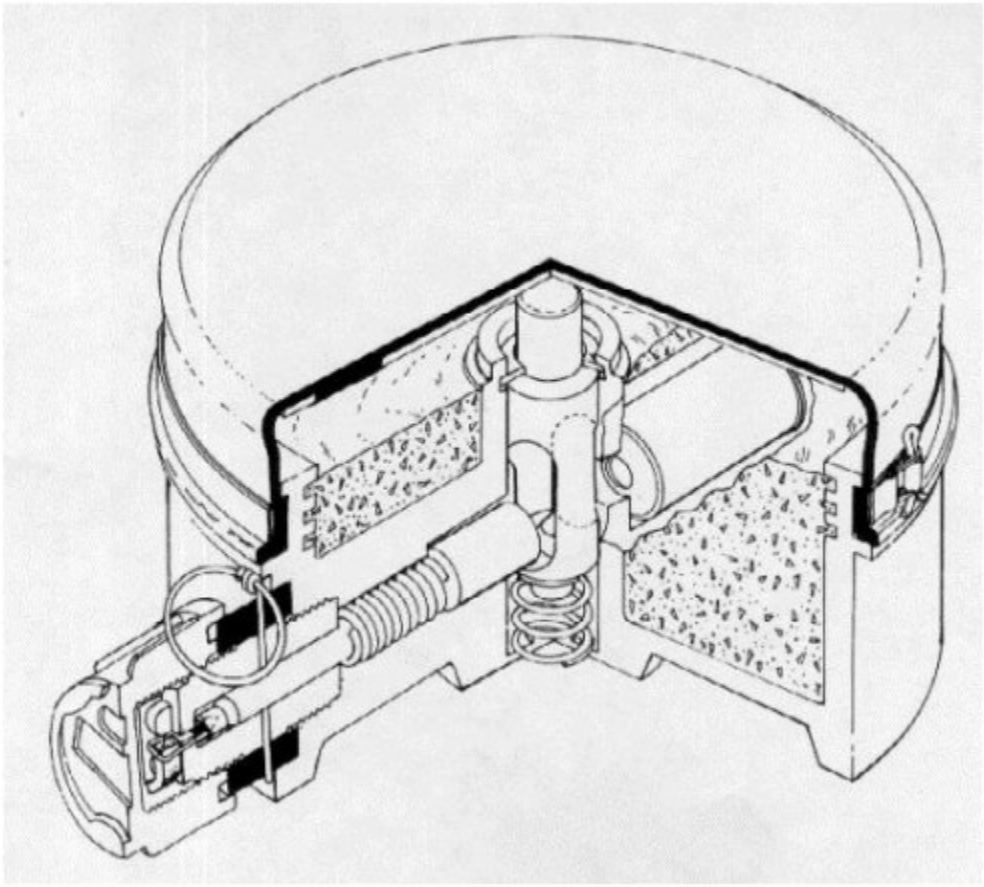
This refers to the Chinese Type 74 ground-based system, a multiple launch rocket system (MLRS) mounted on a three-ton all-terrain vehicle. This system has ten launch tubes for 284mm rockets armed with mines. The missiles have a launch range of 15 km.

Chinese Type 74 remote-controlled mining system. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

China's mine exports are dominated by pressure-type antipersonnel mines. These include, first and foremost, the Type 58 mine (a copy of the Soviet PMN mine), the Model 1989 (a copy of the East German PPM-2 mine), and its own original design, the Type 72.

A Chinese Type 58 antipersonnel explosive mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The Type 58 mine is widely used worldwide, and its main drawback is its excessive metal content. However, this also contributes to its durability. The mine's spring-loaded striker fuse is held in place by a lug in the pressure rod window and, due to its excellent sealing, is extremely durable.



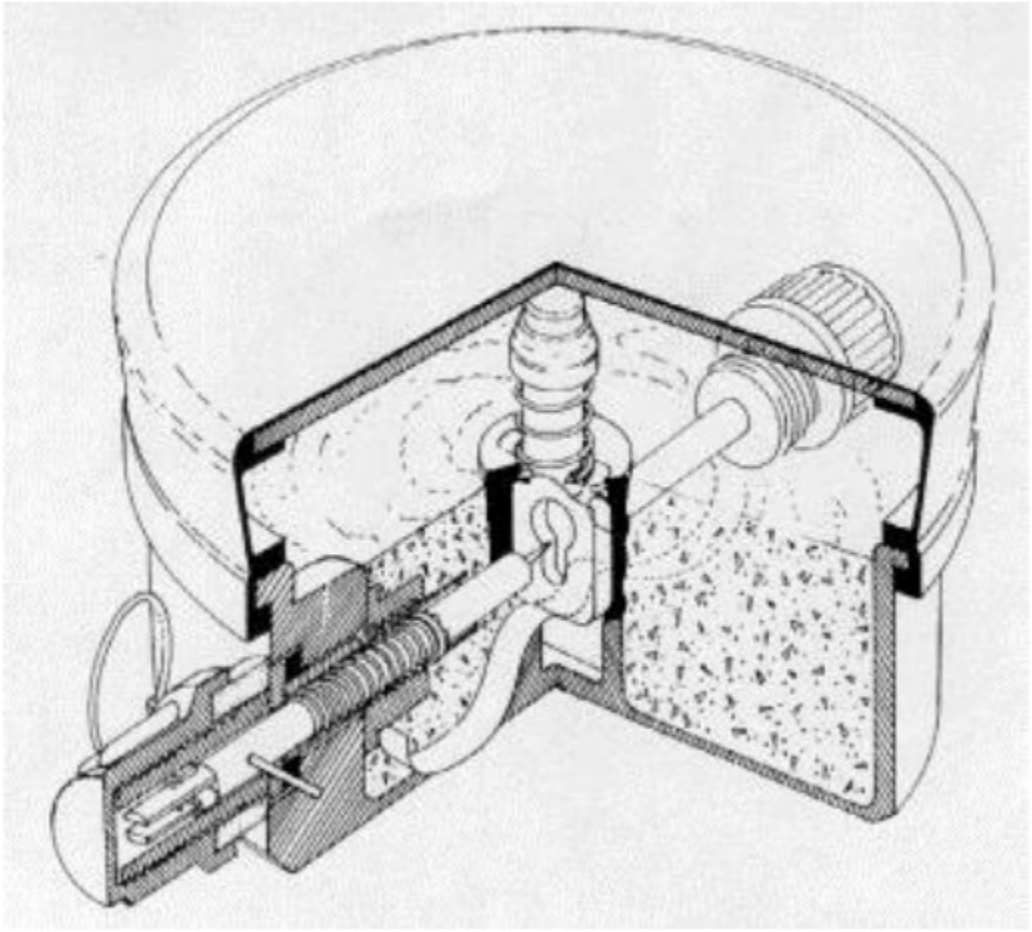
Cross-section of a Chinese Type 58 high-explosive anti-personnel mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The Type 58 antipersonnel high-explosive pressure mine has a bakelite body and a charge of 200 g of TNT. It has a diameter of 112 mm, a height of 56 mm, and a total weight of 550 g.

This is one of the most powerful high-explosive antipersonnel mines in the world, used widely in military conflicts. When the mine's lid is pressed, the striker passes through a window in the piston rod located under the lid's pressure plate and strikes the detonator cap. Due to the mine's high sensitivity to pressure and the piston's ability to slowly sink under the pressure of dirt and soil, defusing this mine is not recommended.

In addition to the Chinese copy of the PMN mine, several other copies, as well as very similar mines, are produced around the world.

For example, the Hungarian Gayata-64, which differs from the PMN by one and a half times, has a larger explosive charge (300 g of TNT), weighs 520 g, has a diameter of 106 mm, and is 61 mm high.



Cross-section of a Hungarian Gayata-64 high-explosive anti-personnel mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

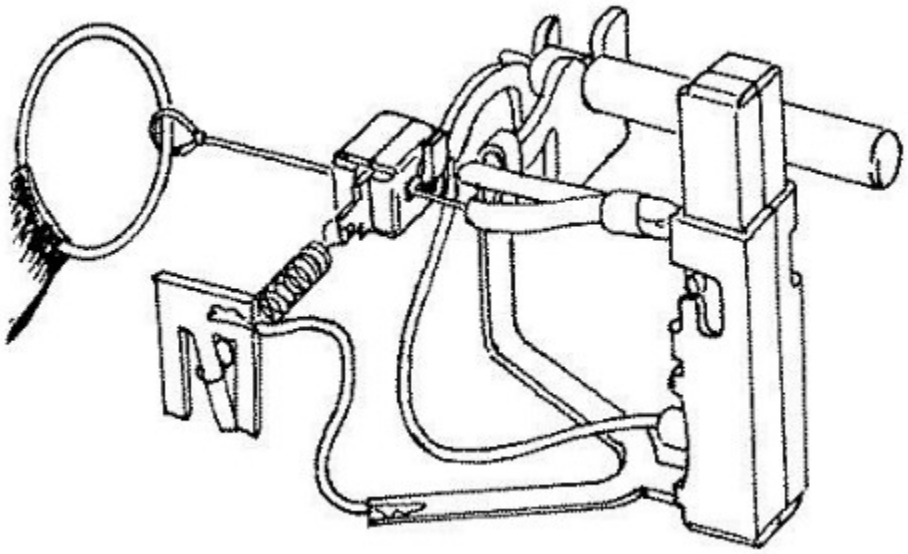
The mine is similar to the Soviet PMN, with the difference that the piston rod, through which the striker passes when triggered, is equipped with two springs, to prevent accidental triggering under the pressure of dirt, rotten leaves, and other foreign objects accidentally falling on its cover. The mine is defused in the same way as the PMN (by unscrewing the fuse plug and removing the fuse), with the difference that defused by the latter is more dangerous due to the greater risk of the piston being released during prolonged exposure to the ground.

Hungarian Gayata-64 anti-personnel high-explosive mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

In the former GDR, the PPM-2 (PPM-2) anti-personnel high-explosive pressure mine was developed and produced to replace the Soviet PMN mine.

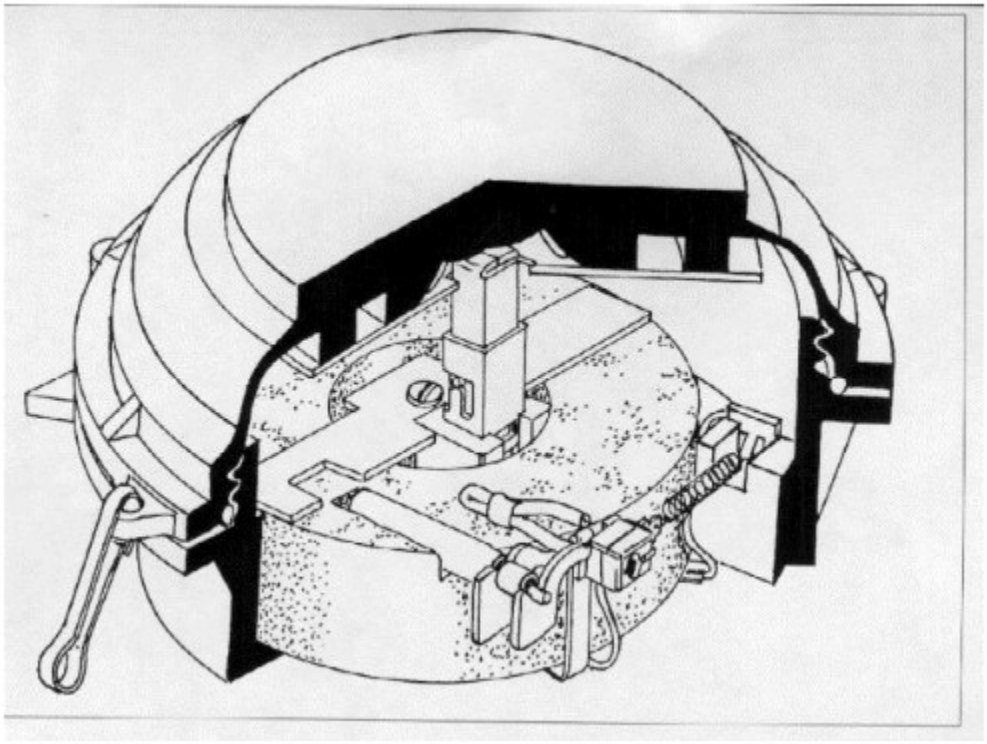
PPM-2 antipersonnel high-explosive pressure mine produced in the GDR. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The PPM-2 mine is quite durable, as it uses a piezoelectric generator driven by a plastic rod whose upper end rests on a pressure disc under a rubber cover. This mine has a charge of 110 grams and a total weight of 370 grams. Its rounded cylindrical black plastic body consists of two twisting halves with ribs. The lower half contains an integral fuse with a long-range arming mechanism (a metal element with a delay of 90-180 minutes) held in the neutral position by a safety catch protruding from the lower half along with a ring. A rounded rubber pressure cap protrudes from the upper half, to which two clamps are attached. In the transport position, one wire (gray) from the piezoelectric generator is attached to the safety catch. In the transport position, the contacts of the electric fuse are held open. To activate the mine, unscrew the cap, connect the gray wire to the piezoelectric generator wire, screw the cap back on, and pull out the safety ring (thereby releasing the spring-loaded contacts).



Detonator of the anti-personnel high-explosive mine PPM-2(ППМ-2).

The mine's activation occurs when the lid is pressed due to the explosion of an electric detonator, which receives a current pulse from a piezoelectric generator. The piezoelectric generator is based on the ability of a piezoelectric crystal to generate an electric current when physically acted upon (pressed, pushed, or struck). The absence of conventional current sources (batteries or accumulators) in the mine's electrical circuit, the piezoelectric elements' ability to generate electricity, and the absence of stressed elements (springs) in the mine's design make this mine theoretically indestructible.



Sectional view of the PPM-2 high-explosive anti-personnel mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

When disarming a mine, unscrew the top half, lifting it straight up to avoid putting pressure on the detonator rod. If it is impossible to unscrew it, use a sharp knife to cut the rubber pressure cap around the circumference.

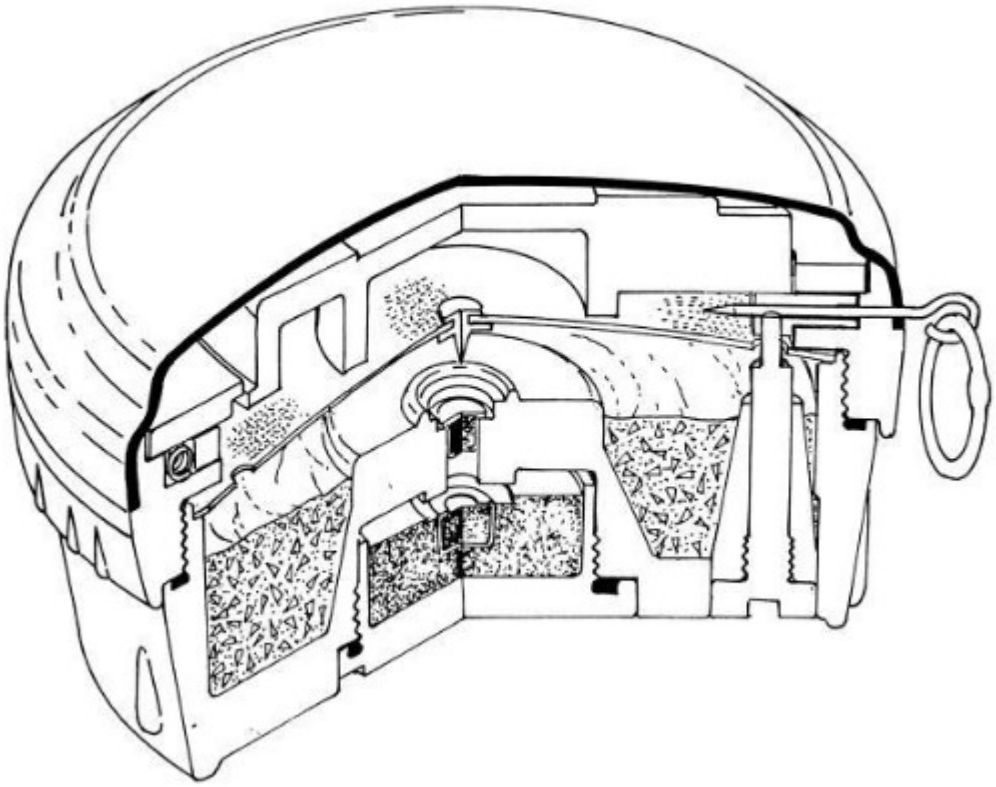
After the reunification of Germany, production of this mine ceased, however, by that time it had begun to be produced in China under the designation Model 1989. There is also a Chinese electronic modification of the PPM-2 mine with an anti-handling device similar to the T-72B mine, but with a 30-degree activation angle.

China also developed its own mine of this class, the Type-72, which was sold in large quantities for export and was used during the war in Yemen.

Moreover, in China, there are also anti-personnel fragmentation jumping mines and anti-tank anti-track mines under the designation Type-72.

A Type 72A antipersonnel high-explosive mine made in China. Photo from Humanitarian Demining www.humanitarian-demining.com

The operating principle of the Chinese Type 72 anti-personnel high-explosive pressure mine (weight 140 g, charge 51 g of TNT, width 78 mm, height 38 mm) is identical to the American M-14 mine: a fiberglass disc spring reinforced with epoxy adhesive, with a short steel striker in the center.



Cross-section of a Type 72 anti-personnel high-explosive mine manufactured in China. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

In the safety position, the pressure cap is rotated so that its protrusions rest against the edge of the casing, preventing it from dropping down when pressed. Rotating the cap to the armed position is blocked by a safety pin with a ring. Furthermore, the cap's downward movement is blocked by a transport bolt, screwed into the mine from below. To arm the mine, the safety pin must be removed. This causes the mine cap to rotate to the armed position under the force of a spring (however, the cap must be further turned by hand until the markings on the cap and the mine casing align). The fuse is screwed into the mine from below.

When the mine is armed, pressing the lid requires overcoming the resistance of the upward-curved disc spring. This ensures a certain force is applied to the mine to trigger it. Once the spring passes its horizontal position, it sharply bends downward. The striker strikes the primer.

Mine defusing is performed in reverse order. The problem is that due to the broken lock (visible in the cross-section), it is difficult to align the safety catch holes in the cover and the mine body, making the safety catch difficult to replace. Another option to defuse the mine is to use a special homemade key to unscrew the transfer detonator cap on the bottom of the mine body. A third option is to unscrew the top of the body. Overall, the T-72A is perhaps one of the best mines available – it is inexpensive, and after installation, there is not a single part under mechanical stress.

When defusing mines, it is important to keep in mind that there are T-72B series mines with electronic mechanisms that prevent them from being rendered harmless, and that visually distinguishing between the T-72A and T-72B is difficult, as the T-72B differs from the T-72A only in its triangular-shaped safety pin ring.

A Chinese-made Type 72B high-explosive antipersonnel mine with a triangular safety ring. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The T-72B is a modification of the T-72A mine, whose operation is based on the closure of electrical contacts when the lid is pressed. A button-type battery is used as a power source.

The underside of a Type 72B antipersonnel high-explosive mine made in China. Photo from the Humanitarian Demining website www.humanitarian- demining.com

In addition, this mine is equipped with an anti-handling device—a free-rolling ball that closes the firing contacts when the mine is tilted more than 10 degrees or moves horizontally. It is powered by two 3-volt batteries.

Cross-section of a Type 72B anti-personnel high-explosive mine manufactured in China. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

There is also a variant of the Type 72C (Type 72C) mine with a self-destruct device. These mine variants can be distinguished only by the shape of the safety pin ring (round, triangular, and square, respectively).

The Swedish LI-11 mine (military designation Truppmina 10) was also used in wars in the Middle East and Africa. It had two components: one conical and the other (lower) with a conical recess, connected by rubber. When the upper part, containing the fuse with a disc spring, moves relative to the lower part, containing the explosive charge, the mine detonates.

Anti-personnel high-explosive mine LI-11.

This mine was purchased by Austria, Switzerland, and some Third World countries, and was produced in Germany under the designation DM-11.

Another mine encountered in the Middle East was the Bulgarian PM-79 anti-personnel high-explosive pressure mine.

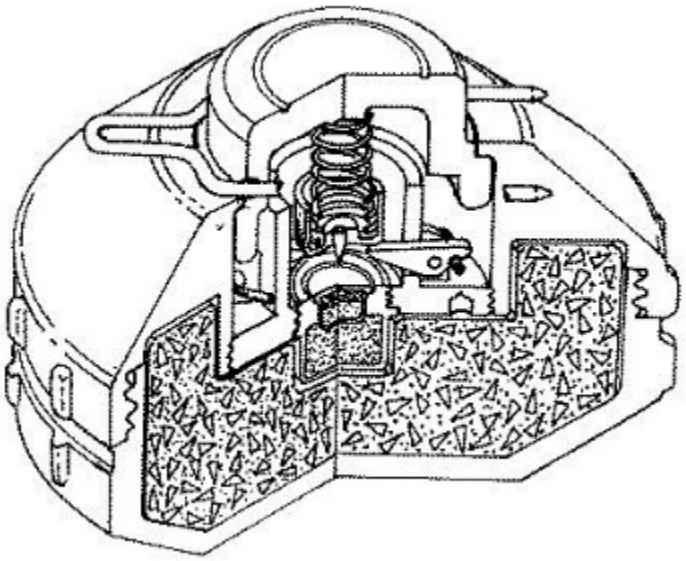
PM-79 high-explosive antipersonnel mine. Photo from the Humanitarian Demining website www.humanitarian-demining.com

Weighing 250 grams, containing 75 grams of TNT, measuring 88 mm in width and 50 mm in height, it had a green cylindrical plastic body containing an integral fuse with a long-range arming mechanism (a metal element with a delay of 2-240 minutes).

The striker of this mine is similar to that of the Soviet mine and also has a delay timer with a slotted metal element. In the armed position, it also rests against the edge of the window of the pressure sleeve, located in the mine's sleeve. The sleeve has a fuse on its second wall, which, in the transport position, is located at the bottom of the mine's sleeve. When pressure is applied to the edges of the cover (but not the center), the lever action causes the cotter pin to rise, pulling the sleeve with it. This forces the fuse against the charge. When the sleeve's window aligns with the striker, the latter strikes the fuse, detonating the mine.

The PM-79 is easily detected by mine detectors, as the pressure plate is made of iron. In principle, using a special key, the firing pin plug can be unscrewed and the firing pin removed.

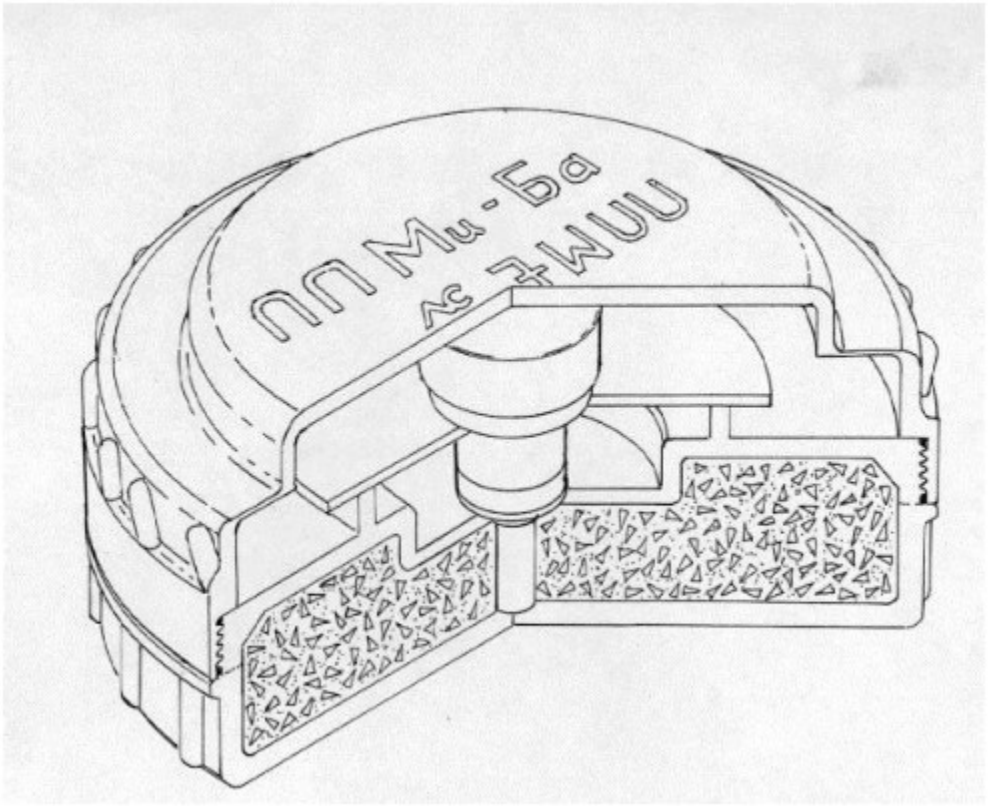
Romania exported antipersonnel mines MAT-68, MAI-75, MAI-GR-2, and MAI-GR-1. The MAI-75 mine was widely displayed.



MAI-75 antipersonnel high-explosive mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The mine body consists of two truncated-conical halves, screwed together. The upper halves house the target pressure sensor and the detonator, while the lower halves house the explosive charge. The pressure sleeve is installed from the inside and held in the upward position by the striker spring. In the safety position, the pressure sleeve is locked by a fork-shaped pin. The other end of the spring rests against the striker, which is held in place by the ends of two double-armed levers. When the pressure sleeve is pressed, it compresses the spring and moves downward. This compresses the free ends of the levers, which, rotating on their axes, lift the striker upward with their other ends, also compressing the spring. When the ends of the levers holding the striker rise almost vertically, they release the striker, which strikes the fuse.

Czechoslovakia produced and sold PP-Mi-Ba and PP-Mi-Na1 high-explosive anti-personnel mines.



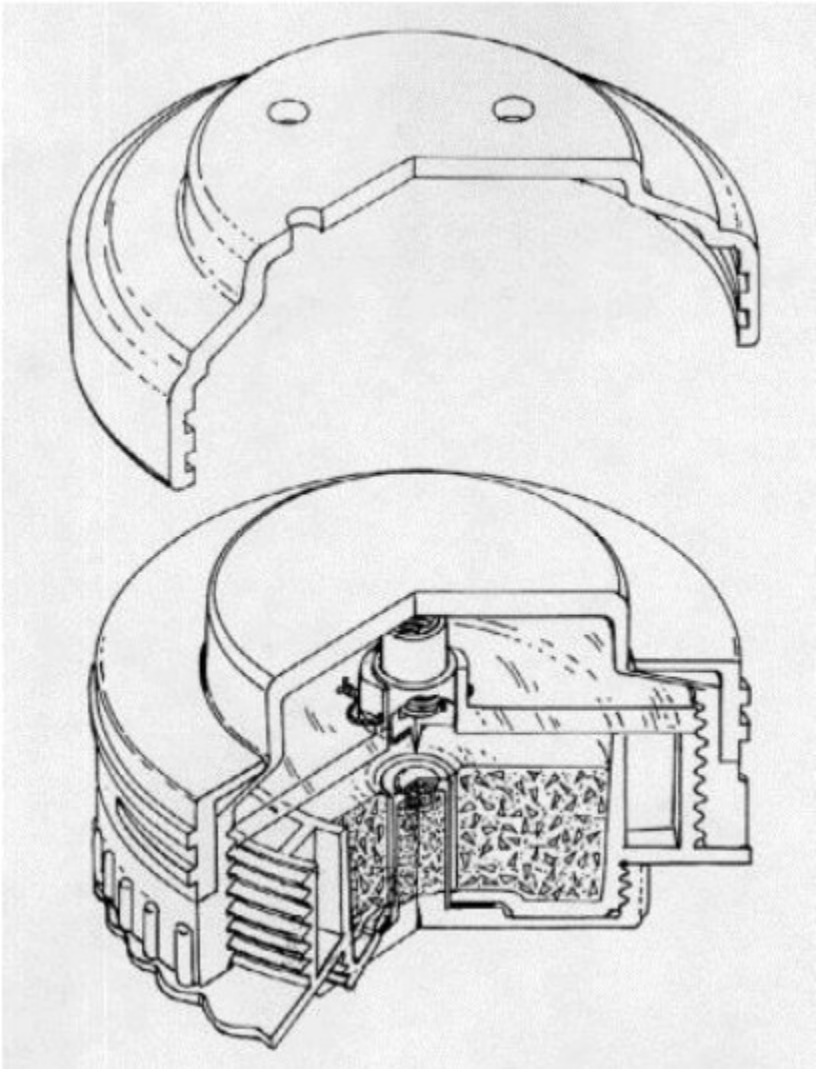
PP-Mi-Ba antipersonnel high-explosive mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The Czechoslovakian PP-Mi-Ba mine (weight 340 g, TNT charge 152 g) consists of two unscrewing halves. The upper part has a pressure-operated breakdown head. The lower part contains the explosive charge and the RO-7-II fuse (also used in anti-tank mines). The fuse has a plastic spring-loaded striker held in place by a shear plate. There are no safety devices. Before use, the upper part is unscrewed and the fuse and detonator, removed from the transport packaging, are inserted into the mine. The upper part is then screwed back in place, and the mine is armed. Due to modern requirements, the mine is quite dangerous to use due to the lack of safety devices.

The Pakistani-made P4 Mk1 anti-personnel high-explosive pressure mine (weight 140 g, charge weight 30 g (tetryl), width 70 mm) has been and continues to be used in the Middle East.

A P4 Mk1 antipersonnel high-explosive mine manufactured in Pakistan. Photo from Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The mine itself consists of three parts: the body with the firing mechanism, the cover of the pressure cap, and the detonator cap assembly with its safety cover. The mine's target sensor is the pressure cover, located on top, resting on a spring with a striker, under which is located the detonator cap. The mine's safety is a removable plastic cap that screws onto the body. When removed and the detonator block screwed into the bottom of the body, the mine is armed.



Cross-section of a P4 Mk1 anti-personnel high-explosive mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The mine is defused by unscrewing the detonator unit, which is screwed onto the bottom of the casing. Then, if present, screw the standard safety cap onto the detonator unit. The mine can be installed in the ground with a thin camouflage layer of soil or on the ground surface. The mines used in Afghanistan were typically painted sand-colored.

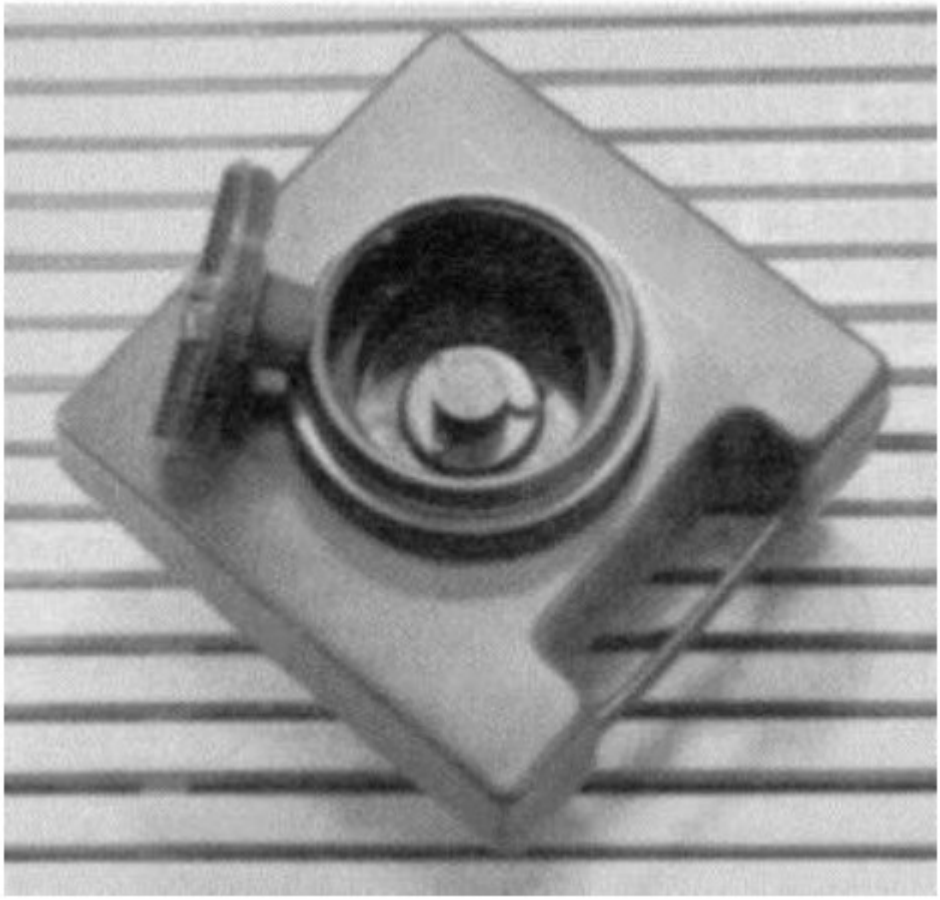
This P4 Mk1 mine, like the similar Pakistani P2 Mk2 anti-personnel mine, is used as a fuse in the Pakistani P3 Mk2 anti-tank, anti-track mine.

A P3 Mk2 anti-tank, anti-track mine manufactured in Pakistan. Photo from Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

This anti-tank mine has a cylindrical plastic body with a round, ribbed, push-button cap. It has a canvas handle for carrying. The mine weighs 7 kg, and the explosive charge (TNT) weighs 6 kg. The diameter is 270 mm, and the height is 115 mm.

The mine is triggered by a load applied to the pressure cap, which presses on the anti-personnel mine located underneath. In Afghanistan, these mines are widely used on unpaved roads and convoy routes. There is another version of the P3 Mk1 mine, which differs from the original only in the shape of the casing (square in plan).

A similar system of using an anti-personnel mine as a fuse for an anti-tank anti-track mine was also used in Brazil, where anti-personnel and anti-tank mines with the identical name T-AB-1 were developed.



T-AB-1 anti-tank anti-track mine manufactured in Brazil. Photo from Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The T-AB-1 anti-tank, anti-track mine, weighing 5.9 kilograms, had a very simple design, consisting of a prismatic, olive-green plastic box 243 mm long, 243 mm wide, and 138 mm high, which contained a 5.2-kilogram charge of TNT.

A T-AB-1 high-explosive anti-personnel mine was placed inside, while the pressing force (200 kilograms) was determined by a plastic cover on top of the mine.

T-AB-1 antipersonnel high-explosive mine. Photo by Colin King. Landmines in Libya. by Colin King (Fenix-Insight Ltd.). Website http://maic.jmu.edu/

This antipersonnel mine has a minimal metal content, contained only in the steel impact needle (0.36 grams) and the aluminum detonator (0.15 grams). The mine contains a 60-gram charge of pentolite (a mixture of PETN/TNT and TNT) and an intermediate detonator. The mechanical fuse has a detonation force of 20 kg.

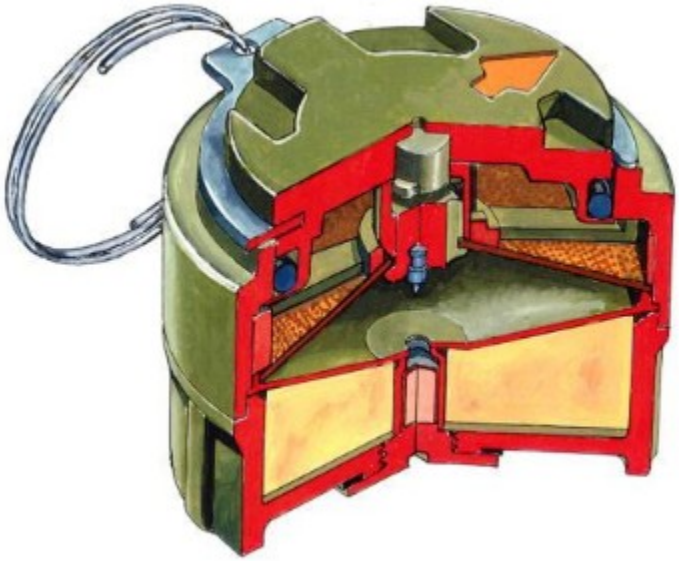
In Libya, mines of this type were widely used in 2011 by various parties due to the lack of control over the Libyan army's stockpiles.

Light and simple mines of this type can be produced in large quantities by any country with even the slightest military production capability, although this makes little sense due to their low cost (around $2-3).

At the same time, similar mines were also produced in the United States, which were exported to many countries around the world, including the Middle East. For example, the M-14 antipersonnel pressure mine was developed and manufactured in the United States.

A US-made M-14 antipersonnel high-explosive mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

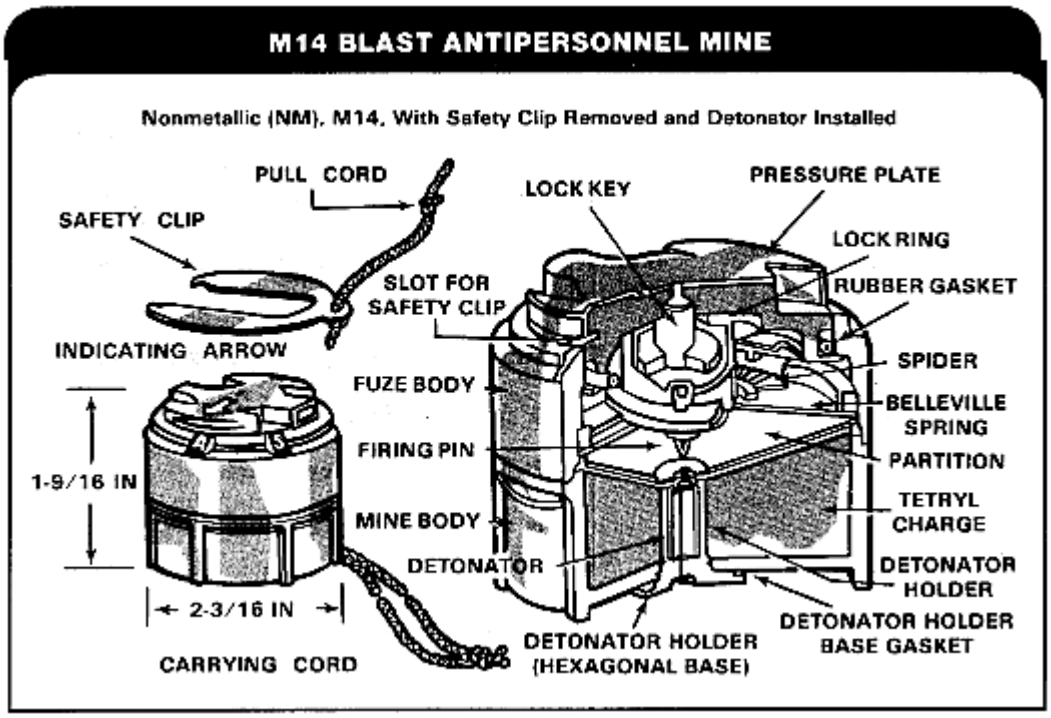
It weighed three and a half ounces (approximately 85 g), was 58 mm wide, 40 mm high, and contained a one-ounce (29 g) tetryl charge. The body was plastic. The design of this mine was essentially the same as that of the Chinese T-72: pressure on the mine's target sensor causes a bent fiberglass plate with a striker in the middle to move, and the striker in the center of the plate strikes a detonator.



Cross-section of an M-14 antipersonnel high-explosive mine manufactured in the USA. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

In the transport position, the mine has a metal U-shaped safety clip that blocks the movement of the target sensor around its own axis. When the safety clip is removed, the pressure plate rotates until the arrow aligns with the letter "A" (ARMED).

When a mine is detected, pick it up and rotate the target sensor until its arrow aligns with the letter "S" (SAFE) on the mine body. According to Field Manual FM 20-32, the design of the American M-14 mine requires that it be rendered harmless by turning the pressure cap to the "S" position and locking the cap with a fork-shaped clip. Then, unscrew the cap and remove the M-46 detonator through the bottom hole.



M-14 antipersonnel high-explosive mine, manufactured in the United States. Source: Field Manual FM 20-32 Mine/Countermine Operations

This is typical of all American mines, although it is possible to turn the lid without the key, provided, of course, it is not damaged. The mine is difficult to detect with mine detectors—its only metal parts are a copper detonator cap and a miniature striker.

The American M-14 antipersonnel pressure mine is widely used worldwide, comparable only to the Soviet PMN and the Italian TS-50, VS-50, and VS MK2. The M-14 is in service with the world's largest armies—the American, Vietnamese, and Turkish—and there are also modifications produced in China and Iraq.

The M-14 mine was also produced in India and Turkey (the Turkish company MKEK suspended its exports in 1996 under government pressure, at least according to official reports), under the same designation M-14. The mine's design, using a disc spring, apparently demonstrated high reliability and was difficult to detect with a metal detector compared to a conventional spring.

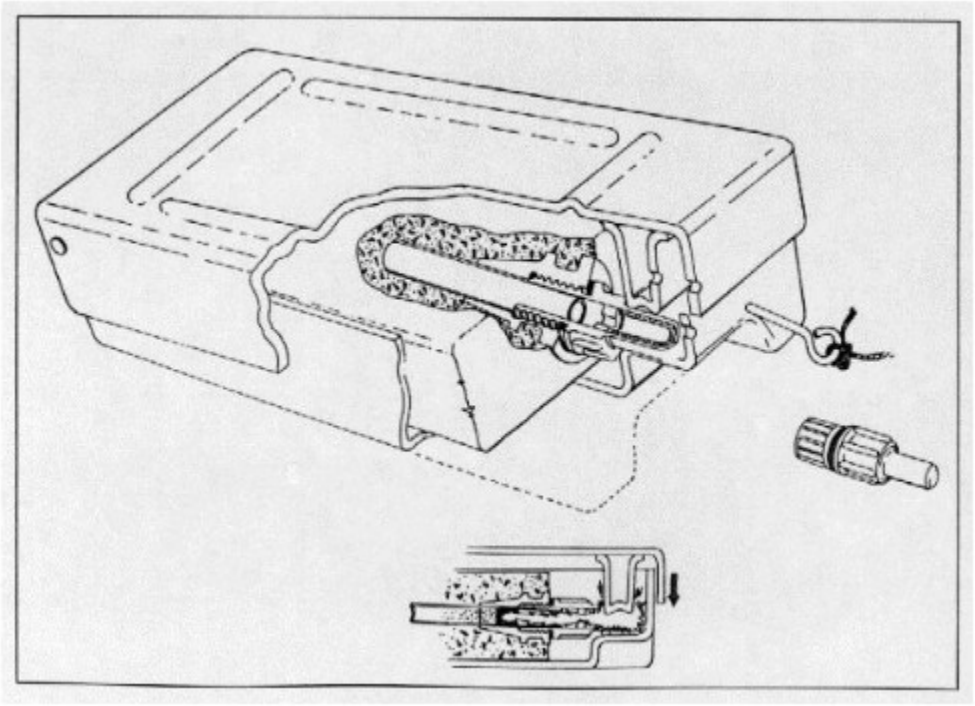
The Indian NM-14 antipersonnel explosive mine, a replica of the US-made M-14 mine. Photo from Humanitarian Demining www.humanitarian-demining.com

Both the Chinese Type 72 mine and the American M-14 mine were produced in South Africa and were widely used by its army during combat operations in Angola, Namibia, and Mozambique.

Mines of a similar class were also produced in the former SFRY and widely exported to the Middle East.

In the 1950s and 1960s, Yugoslavia produced the PMA-1 antipersonnel high-explosive pressure mine, a copy of the Soviet PMD-6, in a wooden casing with a UPM-1 mechanical fuse (a copy of the Soviet MUV fuse). This mine was later replaced by the PMA-1A antipersonnel high-explosive pressure mine.

The PMA-1A antipersonnel high-explosive pressure mine was produced in Yugoslavia in the 1960s and 1970s and had a black bakelite casing. The casing contained a 200g block of pressed TNT, into which a UPMAH-1 detonator was screwed, and into which a No. 8 blasting cap was loosely inserted. The mine was triggered by pressure from a wedge glued to the upper half of the casing, which crushed the detonator body.



PMA-1A anti-personnel mine manufactured in the Socialist Federal Republic of Yugoslavia. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The PMA-1A mine itself, however, proved to be short-lived in the ground, and especially in marshy soil due to the casing's leaky seal, which is why its combat lifespan was only a few months.

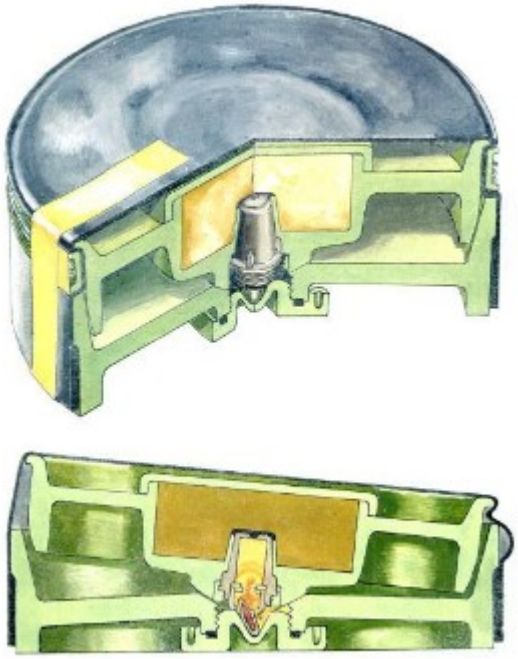
For this reason, the SFRY began producing new anti-personnel pressure mines: the PMA-2 with a chemical pressure fuse - the "star" on top, the UPMAH-2, and the PMA-3 with a chemical fuse. UPMAH-3.

The PMA-3 anti-personnel high-explosive pressure mine had a body made of two loose plastic halves connected by a black rubber cover and a UPMAH-3 chemical detonator, installed through the lower fuze well and triggered by bending the upper half, compressing the detonator's flammable mixture.

Installation of the UPMAH-3 detonator into the PMA-3 mine.

The top half contained a tightly sealed 35-gram charge of TNT, and the bottom half contained a threaded hole, sealed during storage with a plug with a rubber seal. Its large contact surface and good insulation ensure its operation even underwater at a depth of 20 cm.

The fuse body was made of bakelite with a conical top, under which were two sharp-pointed plastic teeth filled with a friction-type igniter mixture, separated from the detonator by a plug with a hole. M17-P-2



PMA-3 anti-personnel mine produced in the Socialist Federal Republic of Yugoslavia. Image from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author: Lyn Haywood.

Moreover, the PMA-3 mine was quite durable when installed in marshy soil.

Another anti-personnel high-explosive pressure mine, the PMA-2, had a polystyrene body and a charge of pressed TNT (70 g) in paraffin, with a tetryl detonator (2 g) installed in its center.

Its UPMAH-2 detonator also had a bakelite body, into which a six-pointed plastic star with a plastic striking pin at the end of its rod was inserted. The rod, like the detonator body, had a hole through which a fuse (2 mm in diameter) was inserted. The detonator contained a membrane in a plug containing a friction igniter mixture, and then a spark was fed through a channel to the M17-P-2 detonator capsule.

Anti-personnel mine produced by the SFRY PMA-2

Chemical friction fuses for pressure mines, similar to the Yugoslav UPMAH-1, are used not only in Yugoslav mines.

Back in the 1950s, France developed a series of anti-personnel high-explosive mines with friction-type pressure fuses. These included the Mi-AP-DVS1, Mi-AP-DV 56, Mi-AP-DV 59, Mi-AP-DV 61, and Mi-AP-DV 63.

The most famous of these mines is the Mi-AP-DV 59, sometimes referred to simply as the 1959 model (M-59) or "Inkstand."

Mi-AP-DN-59 (or Inkstad) antipersonnel high-explosive mine manufactured in France. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

The Mi-AP-DN-59 (or Inkstad) mine was also produced under license in the Netherlands (NR22C1) and used in wars in the Middle East (particularly in the Lebanon War).

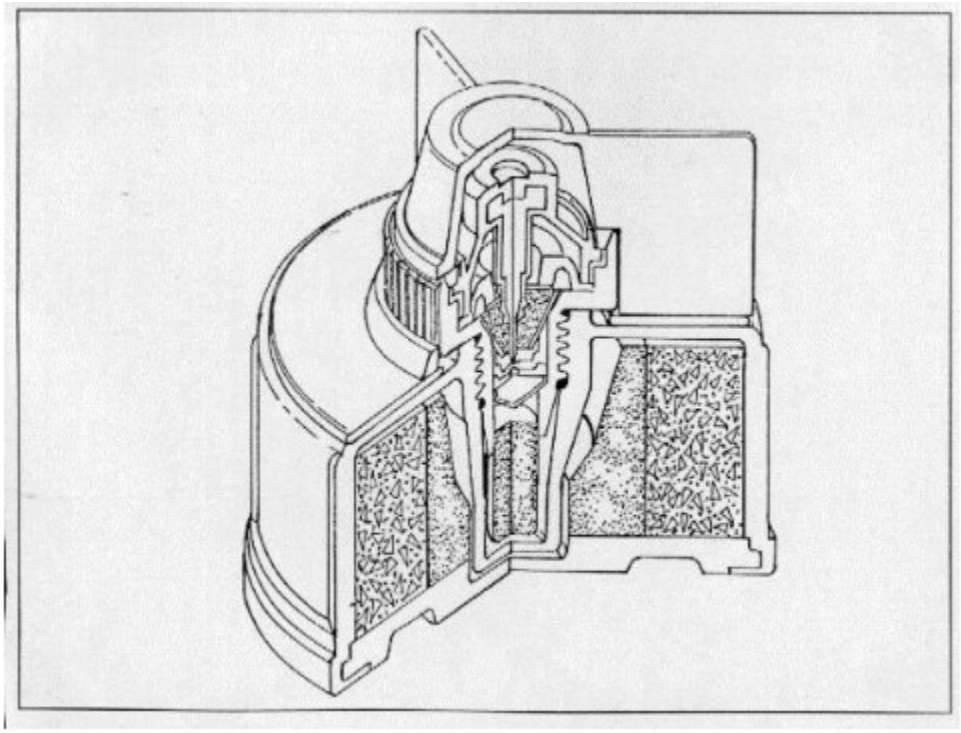
This mine can be easily identified by its pressure head, which is shaped like a cap with three vertical ribs.

This mine weighs 130 grams and contains 70 grams of TNT. Its cylindrical body has a slot on top for the AL-PR-ID 59 friction-type pressure fuse. A safety cap with three vertical ribs is installed on top of the fuse.

Mi-AP-DN-59 (or Inkstad) antipersonnel high-explosive mine manufactured in France. Source: Yu.G. Veremeeva

The mine had a brown or green plastic body, was 62 mm high and 62 mm wide, weighed 130 g, and contained a 70 g TNT charge. This mine was one of the first mass-produced mines with a chemical fuse, which is why it was copied by several European countries. The sealed plastic fuse housing contained a plastic plunger, connected to a pressure head held in place by a breakable cone-shaped dome. The lower part of the plunger was located inside a capsule filled with an incendiary mixture of red phosphorus and glass powder. Beneath the capsule was a plastic blasting cap.

The transport safety is a plastic cover with three ribs, which prevents the detonator button from being pressed. When removed, the mine is reset to its combat position.



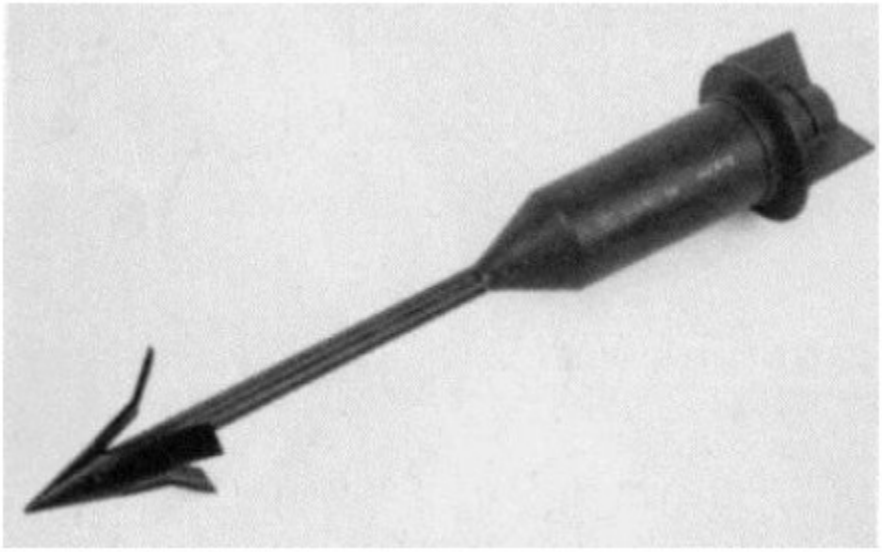
Cross-section of a French-made Mi-AP-DN-59 (or Inkstad) anti-personnel mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

This mine didn't contain a single metal component and was undetectable by any metal detectors. Therefore, to ensure its detection by sappers, a metal ring—a "detector ring"—was installed around the detonator. However, this ring can be easily removed.

When the victim stepped on the detonator, the weight of the foot caused the cone to break, and the plunger, driven by the pressure head, was forced downward. The friction of the plunger against the mixture of glass and phosphorus powder caused a flash of flame, which triggered the blasting cap.

Disarm the mine in the following order: pick up the mine as carefully as possible, without pressing the detonator button, and carefully unscrew the detonator counterclockwise along its axis.

The same detonator was also used in the Mi-AP-DV Piguet 61 and Mi-AP-DV Piguet 63 mines, the main difference between which and the Mi-AP-DV 59 was the presence of a pin mounted on a cone, which was necessary for the mine's functionality in deep sand.



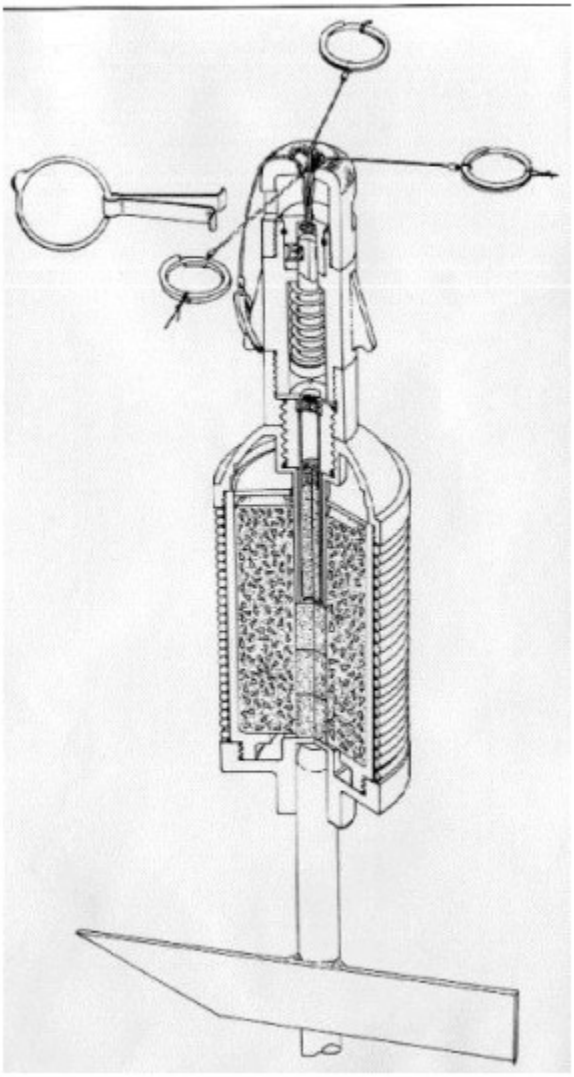
Mi-AP-DV Piguet 61 antipersonnel high-explosive mine manufactured in France. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The NR 413 anti-personnel fragmentation mine, manufactured in Belgium and used in Libya, was also produced with a steel peg attached to the hull.

An NR 413 antipersonnel fragmentation mine manufactured in Belgium. Photo from Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

It’s NR 410 fuse had a sleeve inside, which housed the striker and the striker spring. The spring prevented the striker from moving under the force of the striker spring. Safety balls held the striker and the sleeve together.

Four tension wires were attached to the sleeve by a ring. When one of them was pulled, the sleeve moved upward, and the balls, falling into the outer cavity, released the striking needle.

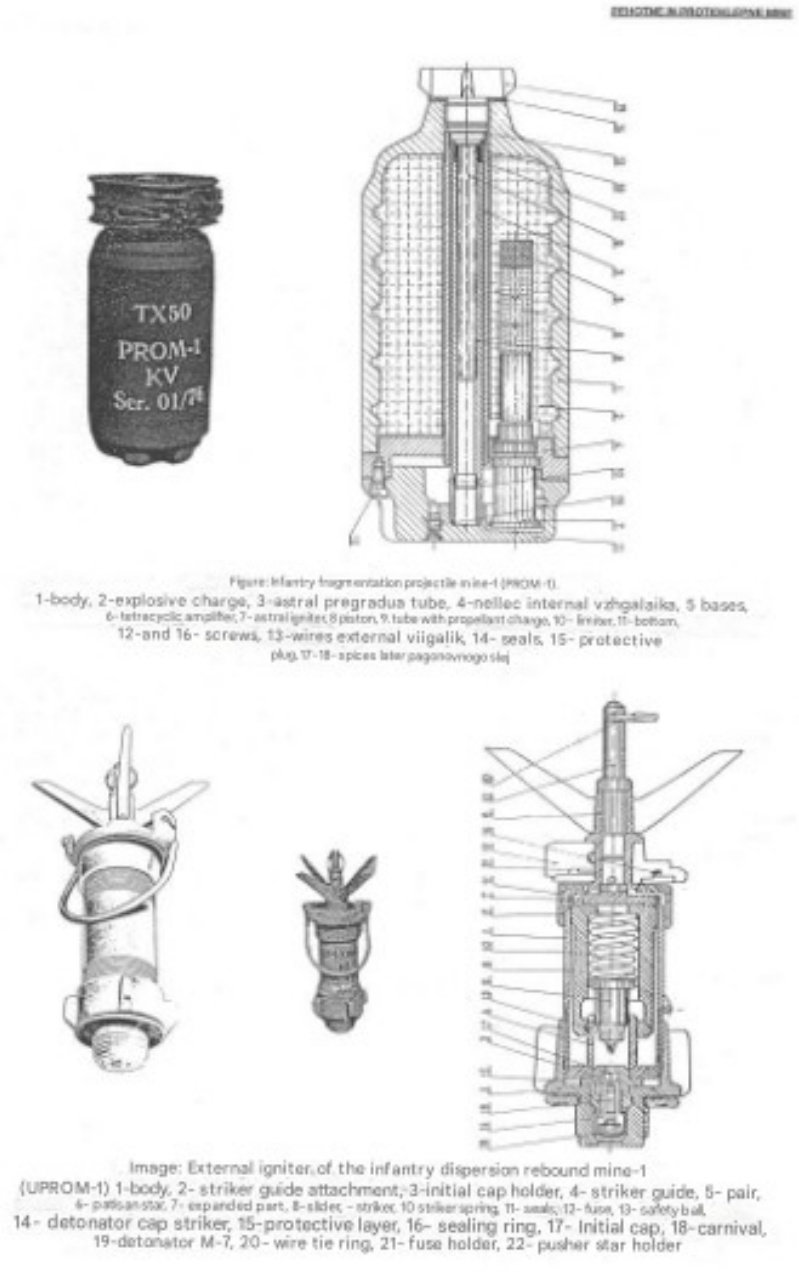


Cross-section of an NR 413 antipersonnel fragmentation mine manufactured in Belgium. Source: Jane's Mines and Mine Clearance 1999-2000 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

In this case, the use of a fuse with both a pull-type and a pressure-type target sensor proved effective.

In Libya, the NR 442 anti-personnel fragmentation mine, with a pressure fuse, was used. It jumps to a height of one meter and hits targets within a 25-meter radius with a spray of 2,500 steel balls.

In Yugoslavia, the PROM-1 anti-personnel, jumping fragmentation mine with a circular destruction pattern, which had a dual-action fuse (simultaneously triggered by a pull-type trigger and a pressure trigger), was developed, produced, and exported to the Middle East.



Anti-personnel jumping fragmentation mine with circular destruction PROM-1, and UPROM-1 detonator.

The PROM-1 mine had a charge of 425 grams of either cast TNT for older types or hexotol for newer ones, with three additional detonators made of tetryl.

The mine had a UPROM-1 detonator, similar in operation and design to the UPMR-3, with the difference being that the latter's fuse was located within the mine's body, while in the former it was an integral part of the detonator.

When the wire was pulled or the star was pressed after the pyrotechnic delay (1.5 seconds) had burned out, the propellant projectile (3 grams of black powder) was triggered, and the mine jumped upward 70-80 (old type) or 20-30 (new type) centimeters. Then, when the cable was pulled, the E-67 primer carrier, attached to this cable, struck the primer with its primer against a stationary striking needle.

Anti-personnel bouncing fragmentation mine with all-round lethality PROM-1. Illustration from Jane's Mines and Mine Clearance 1999- 00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

The flash of the primer cap triggered the detonator cap, which detonated the explosive charge. The mine fragments struck personnel at a distance of 20-30 meters.

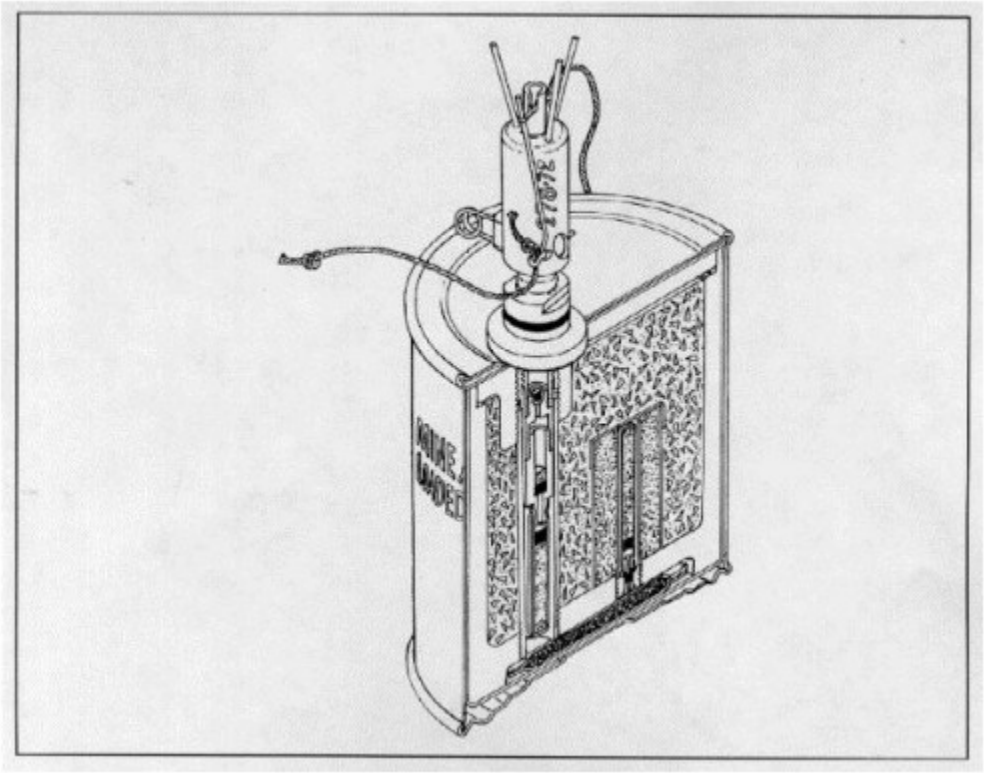
The PROM mine was generally distinguished by its high lethality and, in addition, its durability, due to the fact that both the detonator and the expelling charge were located in the center of the mine body and were well sealed.

This mine is considered one of the best mines of its class, as it has a powerful charge and a total weight of only 3 kilograms, making it convenient to handle, suitable for mining isolated areas obscured from observation, and for sabotage mining of potential enemy movement routes. This is facilitated by the mine's shape and the relatively low-profile UPROM-1 fuse, securely locked by a horseshoe-shaped safety clip.

Moreover, defusing the mine was quite simple because, if necessary, the stem could be blocked with a wire up to 2 mm in diameter by threading the end through the stem and wrapping it around the stem. This mine is completely hermetically sealed; its internal fuse is an integral part of the mine, and the propellant propellant charge is located in the center of the mine in a reddish metal tube, securely sealed from the external environment.

The mine's ability to be used in both pressure and pull-type configurations, as well as its high lethality, made it more suitable than pressure-type high-explosive mines for mining areas where the enemy was conducting reconnaissance and sabotage operations (primarily ambushes) or sniper fire.

It should be noted that the American M-16 mines, which are also produced in India, South Korea, Greece, and Turkey, belong to the same class. They have a similar double-action fuse, the M-605, and an identical total weight-to-charge ratio (8:1).



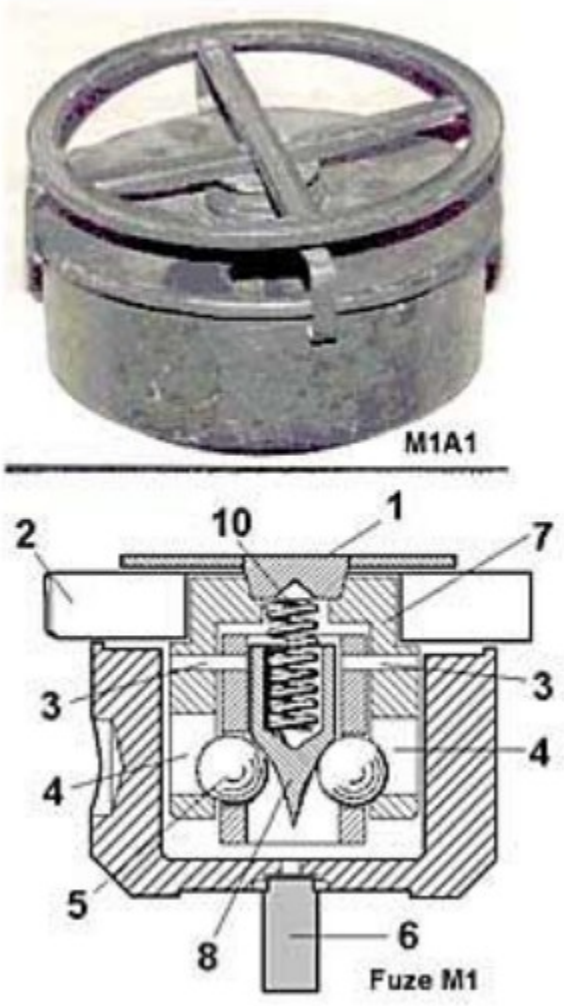
Cross-section of an M-16A2 antipersonnel fragmentation mine, manufactured in the United States. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King)

The United States, which developed a wide range of anti-tank mines, also exported anti-tank mines en masse after World War II.

Thus, at the end of World War II, the US Army used the M-1 (M-1A1) anti-tank anti-track mine with a conventional mechanical pressure fuse, consisting of a spring-loaded striker secured in a cup by two shear pins and held in place by two balls.

The glass itself was located inside a movable sleeve, which was secured in the transport position by a ring-shaped spring-loaded safety catch.

In the firing position, when pressure was applied to the pressure plate connected to the movable sleeve, the entire assembly began to move downward. When the cup hit the bottom of the case, it began to rise, shearing the pins, and after the balls rolled into the empty spaces of the sleeve, the firing pin was released and struck the primer.

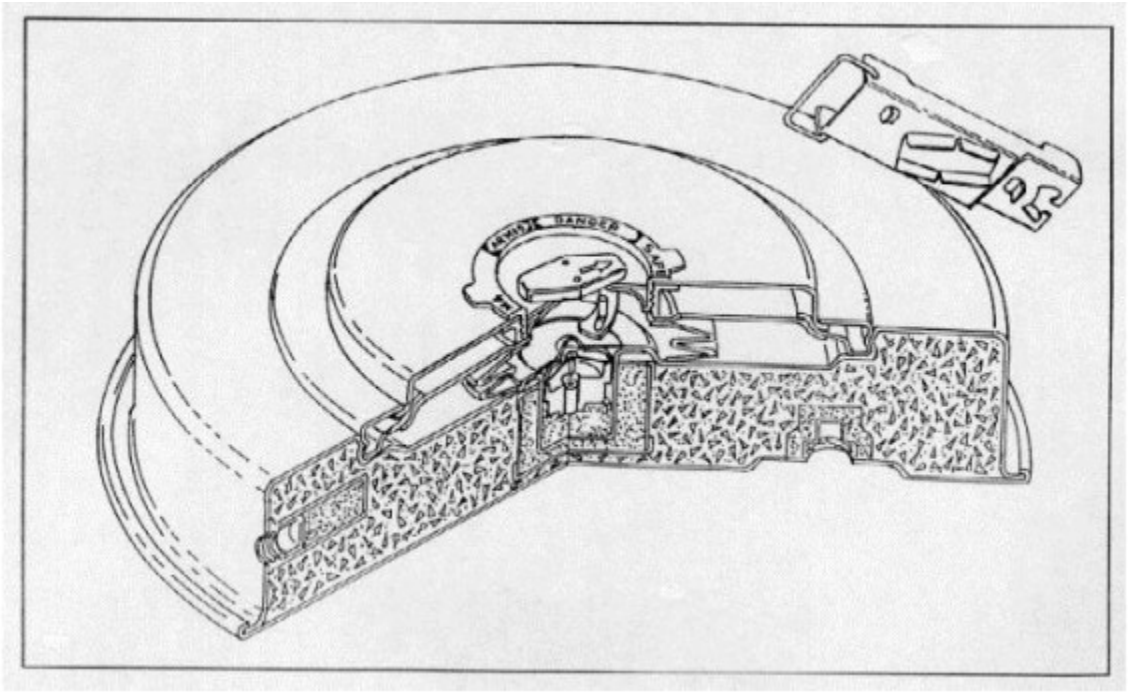


The M1A1 anti-tank anti-track mine, manufactured in the USA.

A distinctive feature of this mine was a pressure cross, instead of the pressure cap (the so-called "spider") common in other mines, resting its center on the detonator and held on the mine by hook-shaped ends.

This American mine was used after the end of World War II during the Korean War (1951-53) and the Vietnam War (1965-75).

A mine of approximately the same type was produced under the designation No. 4 in China and No. 26 in Israel. The light charge (2.75 kg of TNT) of this mine, with a total weight of 5.3 kg, was insufficient for post-war tanks, as was the case with the post-war M-4 mine (weight 4.85 kg, charge 2.75 kg). This predetermined the replacement of both mines in the US Army in the post-war years with the M-6A2 mine (weight 9.1 kg, charge 5.4 kg of TNT), which had either the M-603 mechanical fuze or the M-601 chemical fuse.



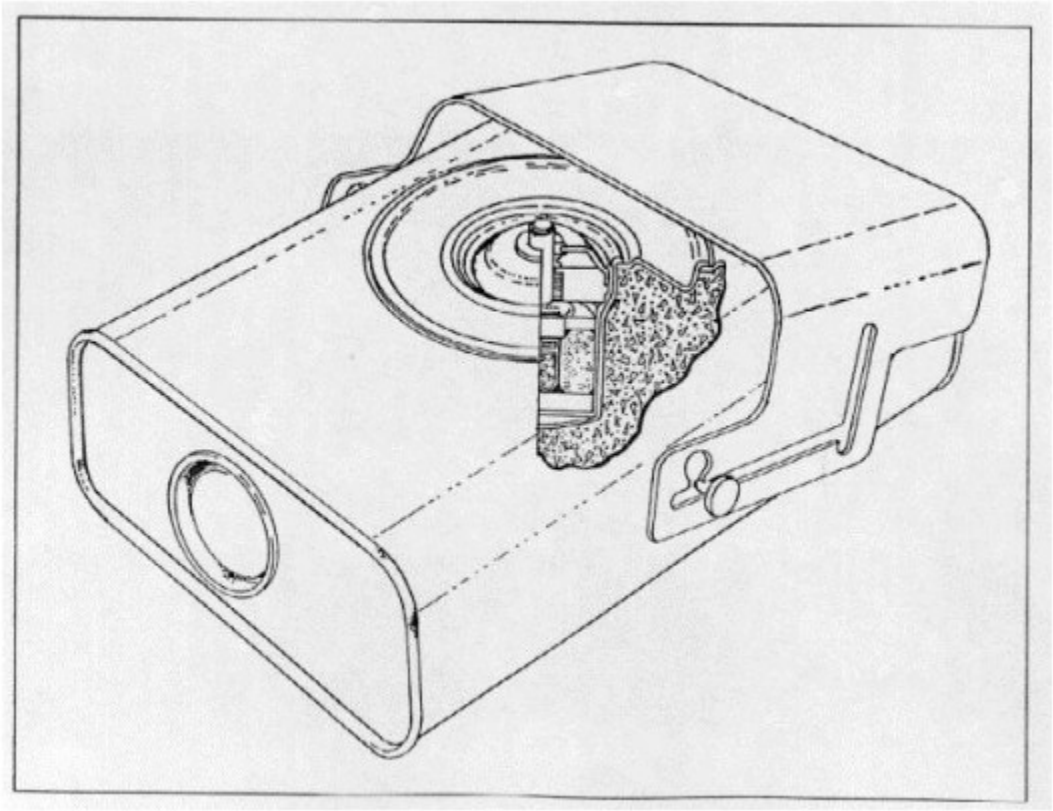
Cross-section of an M6A2 anti-tank anti-track mine manufactured in the United States. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

However, the Americans have long gravitated toward lightweight anti-tank mines with small explosive charges.

Thus, the post-war M-5 mine, which had a ceramic body and a chemical fuse, weighed 6.5 kg and had a charge of 2.6 kg of TNT.

An M-7A2 antitank antitrack mine, manufactured in the United States. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

Another post-war American mine, the M-7A2, had a rectangular body and a sliding pressure cap, weighed 2.2 kg, and had a charge of only 1.6 kg.



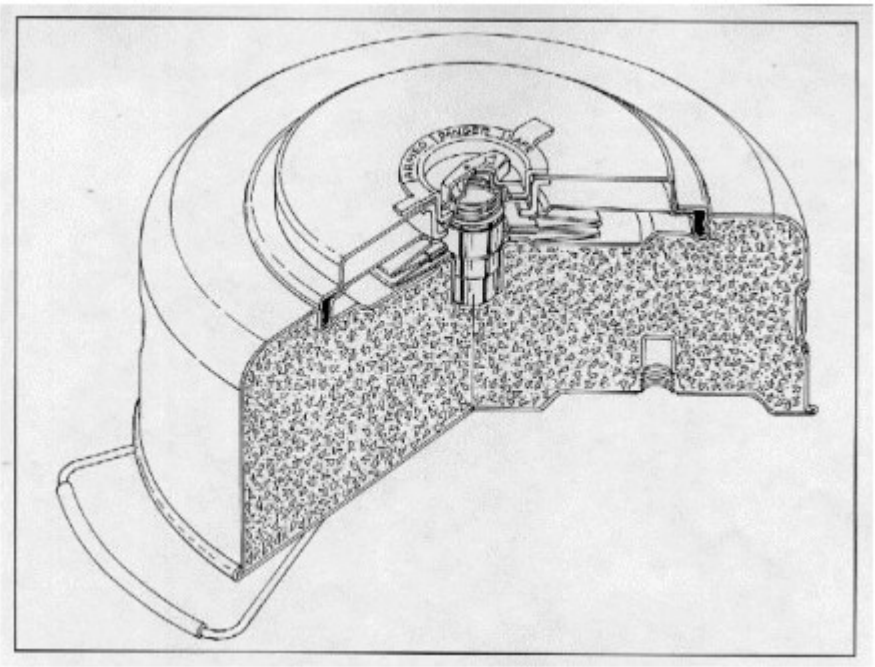
Cross-section of an M-7A2 antitank antitrack mine manufactured in the USA. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King)

Only the later M-15 mine, externally similar to the M-6A2, became significantly heavier (weight 14.3 kg and charge 10.3 kg of hexotol).

A US-made M15 antitank antitrack mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

This mine remains one of the primary American anti-tank and anti-track mines. It is also widely used in Third World countries. Its popularity is due to its ease of use, which is characterized by a simple M-603 pressure-operated mechanical fuse with a disc spring and an M-45 detonator.

The M-15 anti-tank mine has a cylindrical metal body, 333 mm in diameter and 125 mm in height. The mine is triggered by pressing the M-603 fuse, which is armed by aligning the safety mechanism's arrow with the word "ARMED" on the body.



Cross-section of a US-made M-15 anti-tank anti-track mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King)

It's important to remember that the mine has a recess for a fuse in the bottom of the casing. A secondary detonator is located in the center of the mine, under the fuse recess. To arm the mine, simply unscrew the cover, remove the safety clip from the fuse, and lower it into the recess. Then screw the cover back in place. The cover has a rotary switch, which, when turned to the A (armed) or S (safe) position, switches the mine to the armed or safe position.

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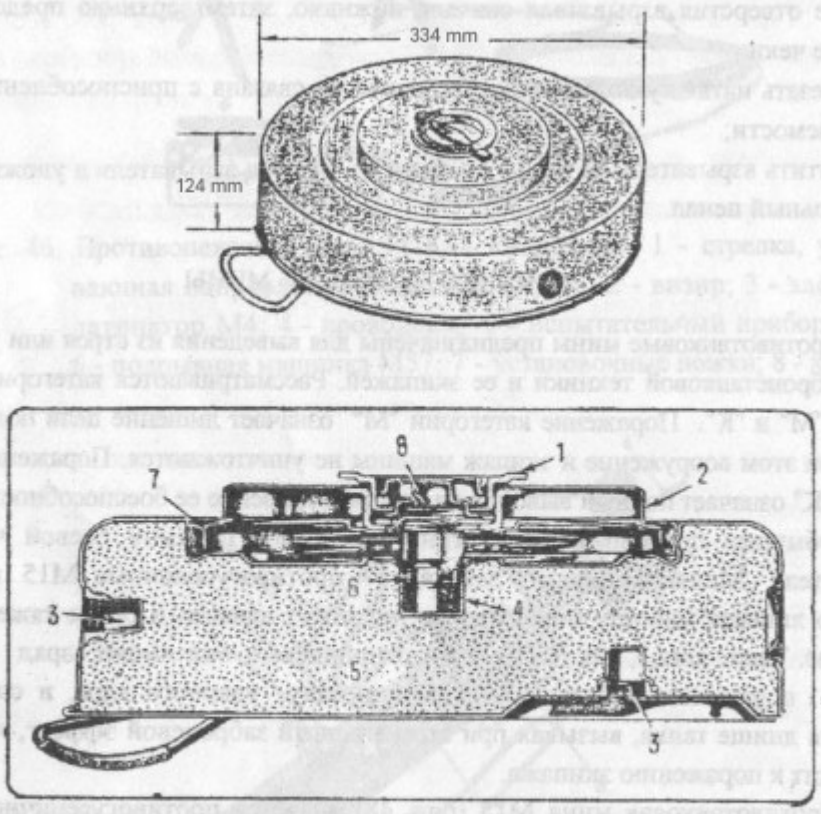
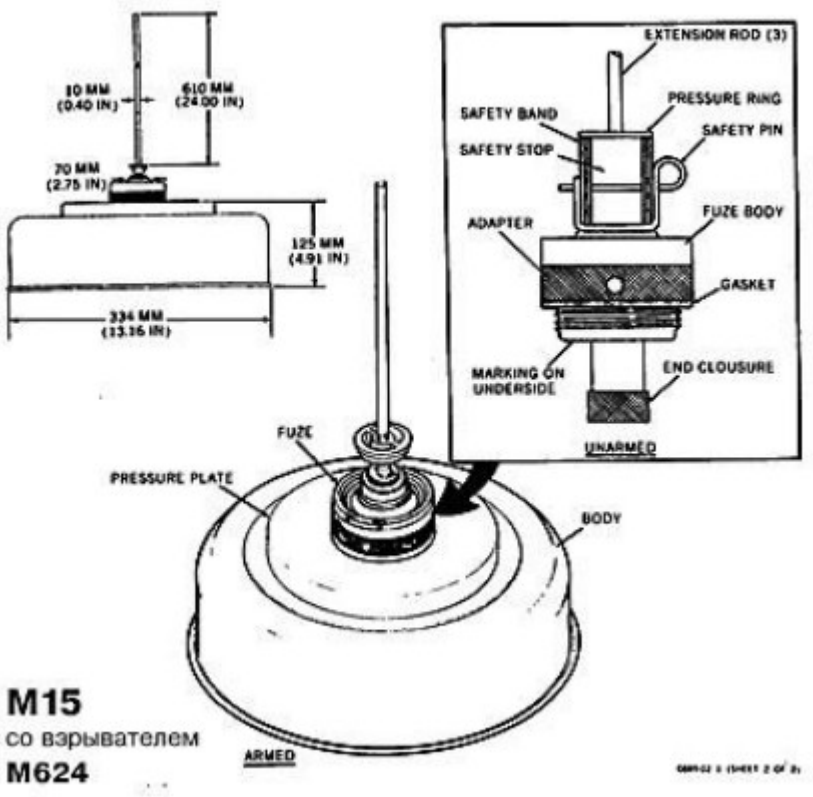


Fig. 48. Anti-tank mine M15: 1 arming mechanism; 2 push-button umbrella cover; 3 additional socket; 4 additional amarok from the M120 detonator; 5 explosive charge; 6 detonator M603; 7- pro-VASOM masonry; 8 detonator locking spring 200m apovesagra

The mine is rendered safe by aligning the arrow on the safety device with the word "SAFE," then unscrewing the threaded plug from the neck of the pressure cap; removing the fuse from the mine's fuse socket and inserting the safety fork into it; and screwing the threaded plug into the mine.

This method of converting a mine into a combat or safe (preventive) position has become traditional for American mines.

The M-15 mine can be used not only as an anti-track mine, but also as an anti-bottom mine.



To do this, use the M-624 pin fuse, which has a safety catch in the form of a cylindrical bracket that blocks the pin from tilting and triggering the fuse. This same fuse, without the extension pin, can also be used in this mine as a pressure-actuated fuse.

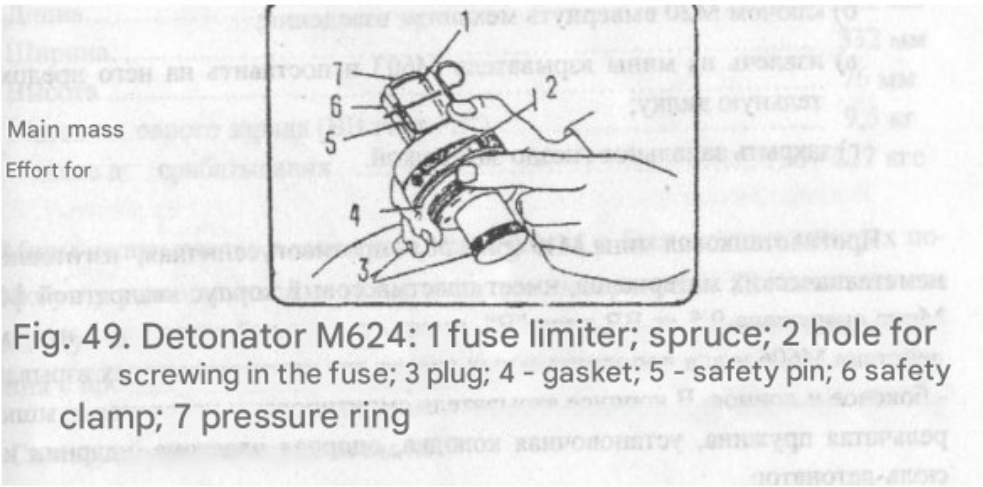


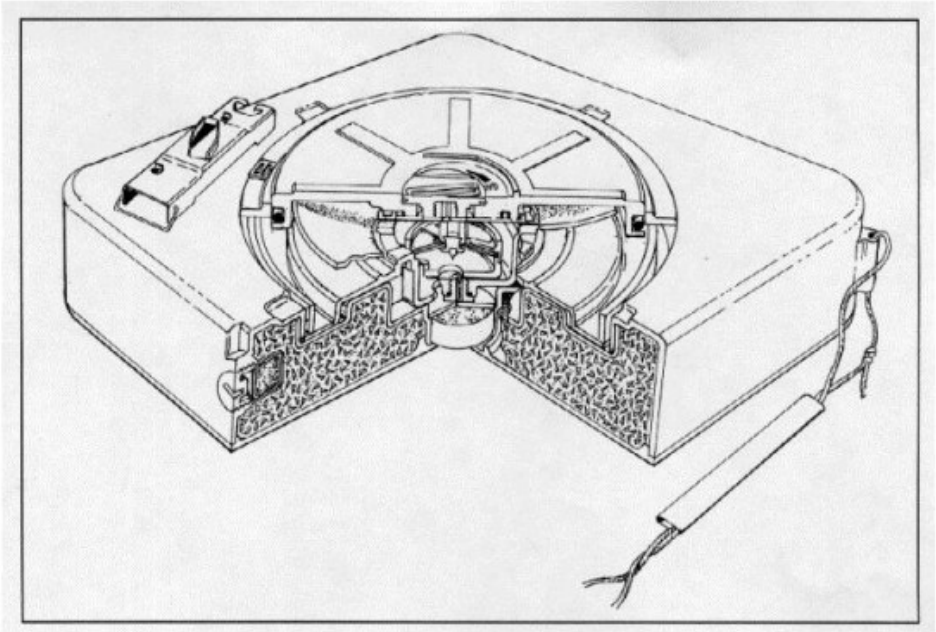
Fig. 49. Detonator M624: 1 fuse limiter; spruce; 2 hole for screwing in the fuse; 3 plug; 4 - gasket; 5 - safety pin; 6 safety clamp; 7 pressure ring

The M-608 pressure fuse, which has increased resistance to explosive demining equipment, has also been developed for this mine.

The development of mine detection equipment and the need to develop mines with a non-metallic casing led to the creation in the United States of the M-19 anti-tank anti-track mine with a square plastic casing.

A US-made M19 antitank antitrack mine. Photo from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The target sensor of this mine is a round pressure cap in the center of the mine, which houses the M-606 integral pressure-type fuse. This fuse has a pressure head surrounded by a disc spring, which creates the required resistance to pressure (160-320 kg). Below the head is a bushing with a striker, also surrounded by a disc spring, but facing the opposite direction. The only metal parts in this mine are the detonator cap and the striker needle.



Cross-section of a US-made M-19 antitank antitrack mine. Source: Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group, Colin King).

The mine weighs 12.5 kg with a charge of 9.9 kg (Composition "B" - i.e., hexotol). The casing has two slots on the bottom and side for additional anti-handling fuses (equipped with intermediate detonators). As with the M-15 mine, the fuse is armed and safed using a rotary knob in position "A" or "S." If for some reason the knob cannot be turned with finger force, this can be done using a special M-22 wrench.

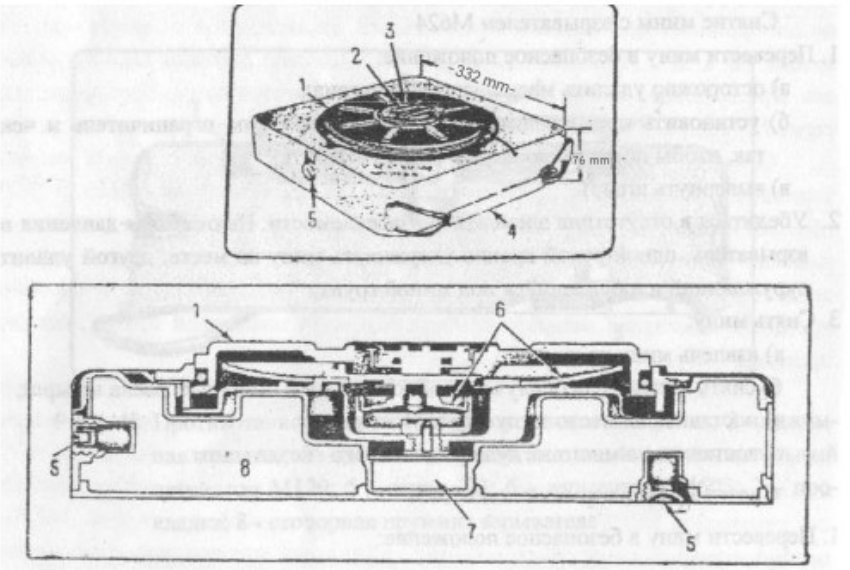


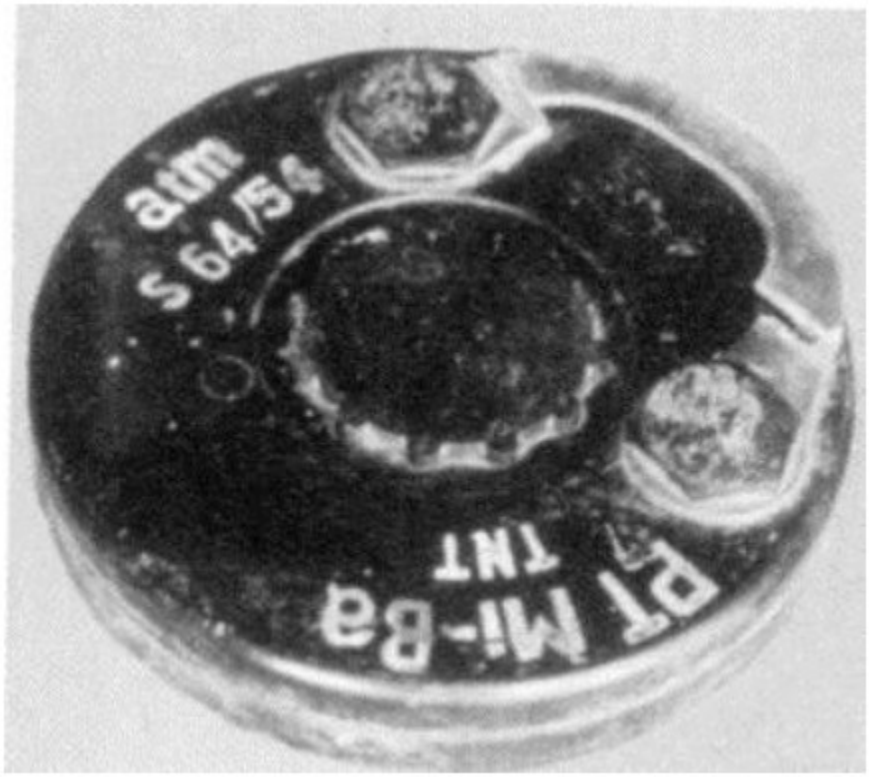
Fig. 50. Anti-tank mine M19: 1 - pressure cap; 2 - arming block; 3 - safety fork; 4 - handle; 5 - additional socket; 6 - leaf spring; 7 - additional detonator (tetryl); 8 - explosive charge

The high explosive charge (hexogen is 1.25 times more powerful than TNT) and the very small amount of metal used made this mine very popular during the Iraq-Iran War in the 1980s. Iran produced this mine alongside mines of the same class: the Italian SB-81 and the Chinese T-72. In the second half of the 20th century, South Korea, Chile, and Turkey also produced this mine.

Mines of this class, produced in the former Czechoslovakia, have become quite widespread in the Middle East, particularly in Syria.

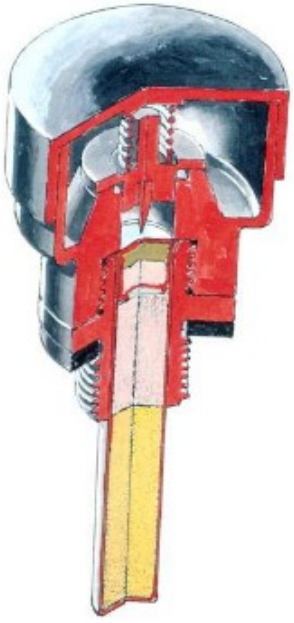
These are primarily the PT Mi-Ba (PT Mi-Ba-53), PT Mi-Ba-II, and PT Mi-Ba-III mines. The bodies of these mines were made of bakelite.

PT Mi-Ba was disc-shaped and consisted of two halves glued together.



PT Mi-Ba anti-tank anti-track mine, manufactured in the former Czechoslovakia. Photo from the Humanitarian Demining website www.humanitarian- demining.com

An intermediate detonator was screwed into the bottom of the mine, which had an RO-7-II pressure fuse in its upper part.



RO-7-II pressure fuse. Illustration from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

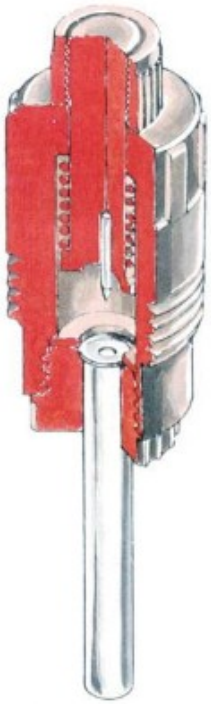
The mine weighed about 8 kg, with a charge of 6 kg of TNT. The fuse had a permanently spring-loaded striker held in place by a breakable disk. This made the fuse excessively sensitive in hot climates.

The same detonator (two pieces) was also used in the PT Mi-Ba-II prismatic mine (weight 9.6 kg, charge 6 kg of TNT) with a removable lid, having two plastic push rods.

PT Mi-Ba-II anti-tank anti-track mine, manufactured in the former Czechoslovakia. Illustration from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

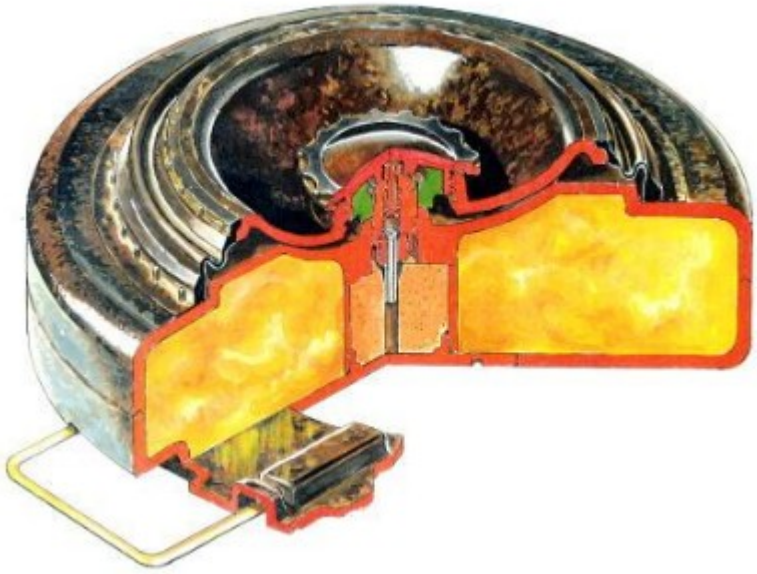
In the transport position, these rods descended into the mine, occupying the fuse positions. When the mine was deployed, the cover was removed, the fuses were installed, and the rods were raised so that the mine could be buried deep in soil. Detecting a mine with fuses containing only a spring and a striker was difficult, if not impossible.

The PT Mi-Ba-III mine (weight 11 kg, charge 8 kg of TNT) had the same disc-shaped body as the first, but a different RO-2 fuse (sometimes designated RO-7-I).



RO-2 (or RO-7-I) fuse. Illustration from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

It operated on a similar principle to the RO-7-II, but had a longer striker tail, which extended outward and was secured by a shear plastic ring. This fuse design made it possible to design a pressure cap in the shape of a plate.



PT Mi-Ba-III anti-tank anti-track mine, manufactured in the former Czechoslovakia. Illustration from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

The fuse socket cover is screwed into the center. On the inside, this cover has grooves into which the fuse's shear ring fits. Pressure on the edges of this "plate" causes it to shift relative to the center, thereby shearing the ring and releasing the striker.

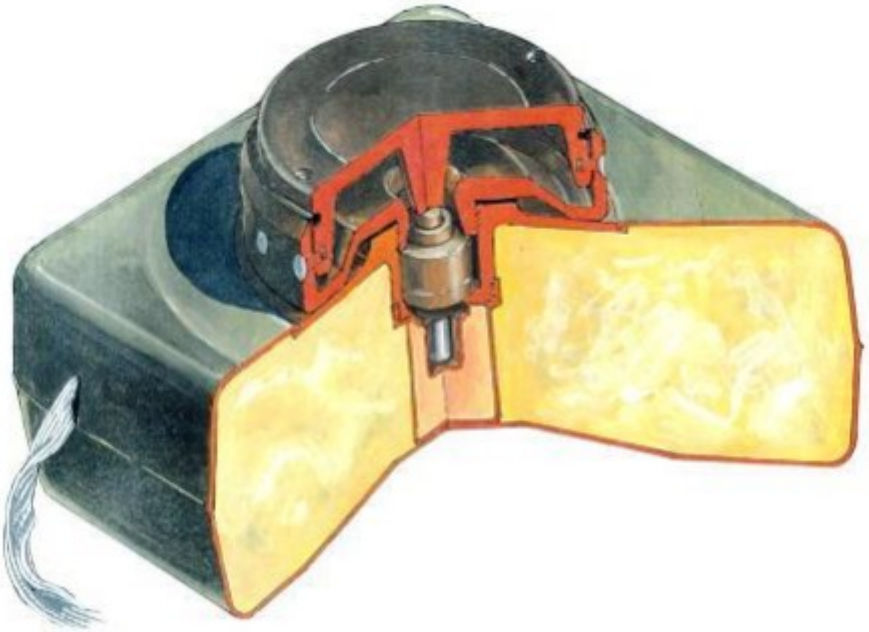
PT Mi-Ba-III anti-tank anti-track mine, manufactured in the former Czechoslovakia. Photo from the Humanitarian Demining website www.humanitarian-demining.com

In Bulgaria, this mine, produced after 1980, had, instead of a transport safety catch installed under the fuse cover, a new cover with a safety membrane, which could be switched from the transport to the combat position by pressing on it with a finger.

In Iraq and Libya, Belgian-made PRB M3 anti-tank and anti-track mines were frequently used.

PRB M3 anti-tank anti-track mine. Photo by Colin King. Landmines in Libya. by Colin King (Fenix-Insight Ltd.). Website: http://maic.jmu.edu/

These mines weighed 6.8 kilograms, and the charge (a mixture of TNT, hexogen, and aluminum powder TNT/RDX/Al (70/15/15)) weighed 6 kilograms.



PRB M3 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

The M30 fuse is screwed into the center of the mine, and a pressure cap is screwed onto the mine. Pressure transmitted from the pressure cap to the fuse head causes a sleeve located under the head to move downward.

The sleeve contains two igniter capsules, and when the capsules move downward, the cavities they occupy align with two spring-loaded strikers located in the fuse body. The firing force is transferred to the detonator, which in turn transmits the explosive impulse to the booster detonator.

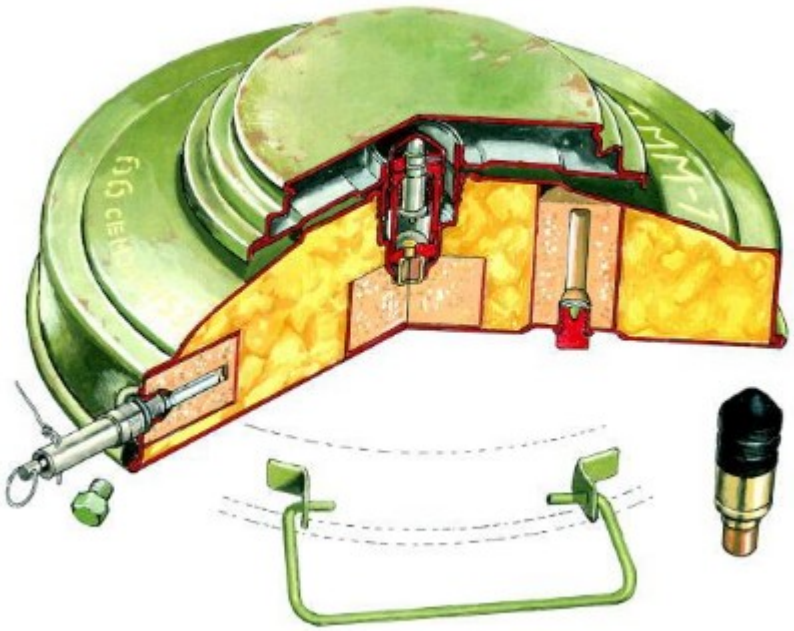
Moreover, in the PRB M3A1 modification, the mine body had two additional detonators (on the side and bottom), with holes extending outward for installing decoy fuses.

PRB M3A1 anti-tank anti-track mine. Photo by Colin King. Landmines in Libya. by Colin King (Fenix-Insight Ltd.). Website: http://maic.jmu.edu/

The wars in Iraq, Kuwait, Libya, and Lebanon saw the use of a large number of Yugoslav-made anti-tank mines, most of which featured a plastic casing and the ability to install detonators on the side or bottom of the mine casing.

Yugoslavia produced a large number of anti-tank mines. This included the Wehrmacht's T.Mi.43 Pilz anti-tank anti-track mine, which was designated the TMM-1 in Yugoslavia.

It weighed 8.7 kilograms, and the charge weighed 5.6 kilograms of cast TNT with one intermediate detonator made of pressed TNT and a detonator made of tetryl. The UTMM-1 fuse (with a pressing force of 70-140 kg) was made of metal and had a striker resting on the cartridge case. Beneath it was an L-6 detonator and two additional detonators on the bottom and side for anti-removal devices.



TMM-1 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

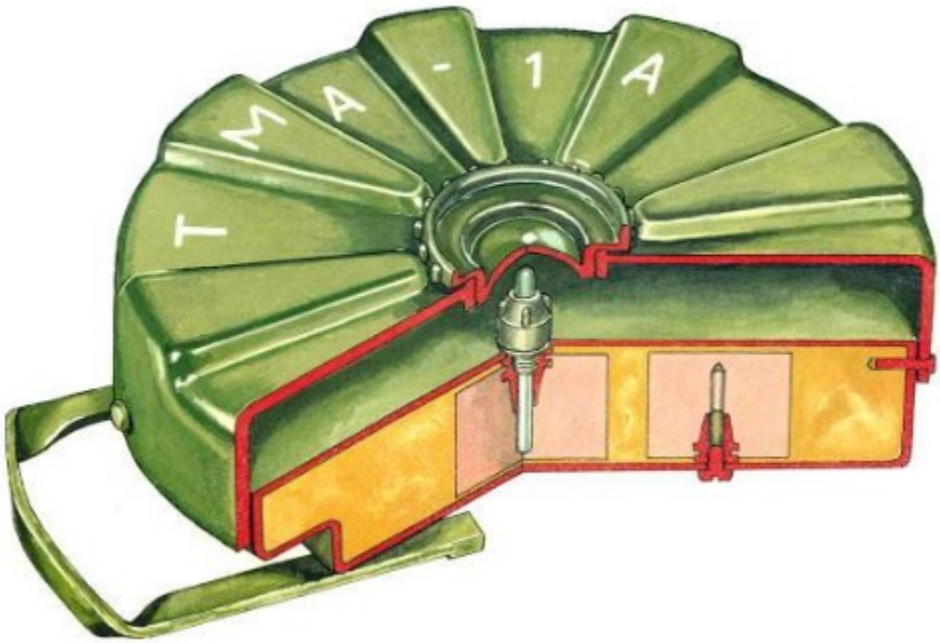
The main type of anti-tank mine exported were mines with plastic casings. They were distinguished by their simple design and relatively low metal content.

Anti-tank anti-track mine TMA-5 produced by the SFRY

Yugoslav anti-tank anti-track mines had a plastic casing (usually green).

Although Yugoslav mines were quite primitive in design, they were fully adequate for the needs of the armies of the Middle Eastern countries on the front lines.

The TMA-1A mine weighed 6 kg, contained a 5.5 kg charge of cast TNT, had a rounded plastic body made of juvidur, connected by four cotter pins that determined the force of the pressure, and a cover for installing one UANU-1 detonator. The mine had one primary intermediate detonator and one secondary detonator made of pressed TNT (190 g).



TMA-1A anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

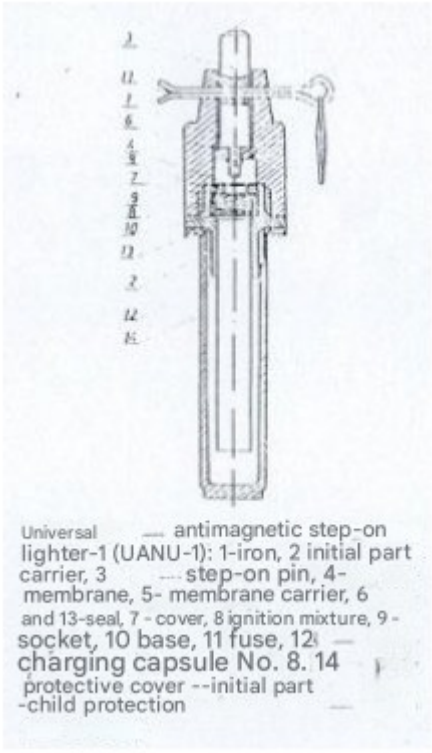
The TMA-2A mine weighed 7 kg, contained a 6.5 kg charge of cast TNT, a prismatic plastic case made of juvidur, connected by four cotter pins that determined the force of compression, and a cover for mounting two UANU-1 detonators, two intermediate and one additional detonator made of pressed TNT (190 g).

TMA-2 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

The TMA-5 mine weighed 5.6 kg and had a charge of two blocks of 2.75 kg of cast TNT each, and a single intermediate detonator of 175 grams of pressed TNT. The TMA-5 mine, also weighing 5.6 kg, had a monolithic charge of 4.5 kg of cast TNT, and a secondary detonator of 200 grams of pressed TNT.

TMA-5 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

All of these mines used the same UANU-1 detonator with a plastic impact pin, containing metal only in the detonator. Characteristically, the detonator itself was activated by a plunger force of only 70 kg.


Universal — antimagnetic step-on
lighter-1 (UANU-1): 1-iron, 2 initial part
carrier, 3 — step-on pin, 4-
membrane, 5- membrane carrier, 6
and 13-seal, 7 - cover, 8 ignition mixture, 9 -
socket, 10 base, 11 fuse, 12
charging capsule No. 8. 14
protective cover --initial part
-child protection

Mine fuse UANU-1. Source: "Manual on mine explosive devices". Trajko Stevanović, Svetislav Petrović. Institute for teaching and learning materials. Belgrade 1987.

Therefore, the mine's trigger force was determined by the strength of the mines' plastic caps, beneath which, a few centimeters away, was the main charge and, correspondingly, the booster. (It should be noted that cast TNT does not detonate with a blasting cap; it requires a booster made of pressed TNT, which responds well to the blasting cap's detonation.) The minimum payload for all of the above-mentioned mines was 120 kg.

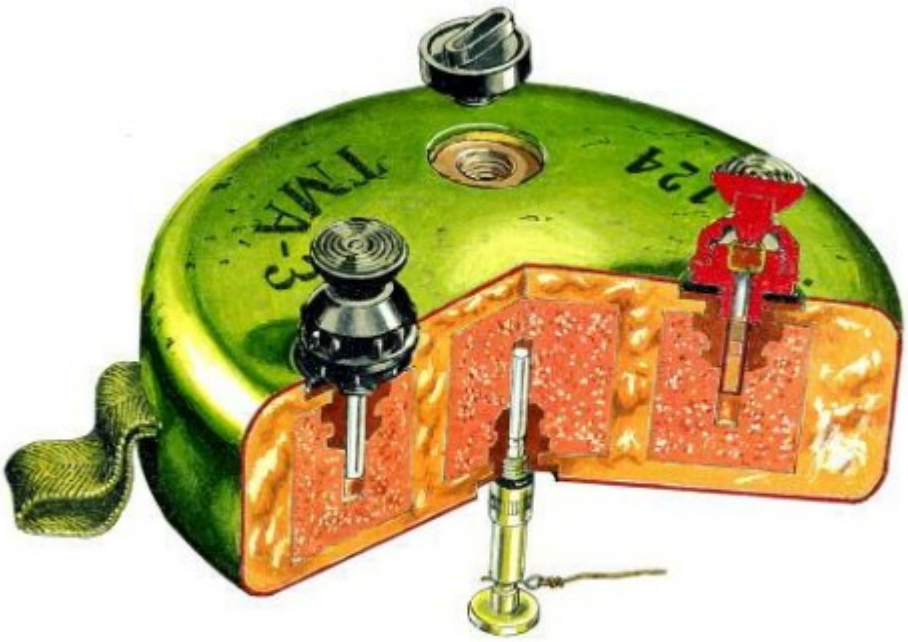
Since the Yugoslav anti-tank mines TMA-1A, TMA-2A, TMA-5, and TMA-5A had a drawback: the large target sensor area, making them highly sensitive to remote mine-clearing devices, the former Yugoslavia developed the TMA-3 anti-tank, anti-track, high-explosive mine (weight approximately 7.5 kg, with a charge of 6.5 kg of cast TNT and four additional detonators of 200 g of pressed TNT, each with a 1.5 g intermediate detonator made of hexogen) and the TMA-4 mine (weight 6 kg, with a charge of 5.5 kg of cast TNT and three additional detonators of 10 g of pressed TNT).

Anti-tank mines TMA-3 and TMA-4

In these mines, the pressure action was applied directly to the plastic pressure caps of the friction fuses - respectively, the UTMA-3 and UTMA-4.

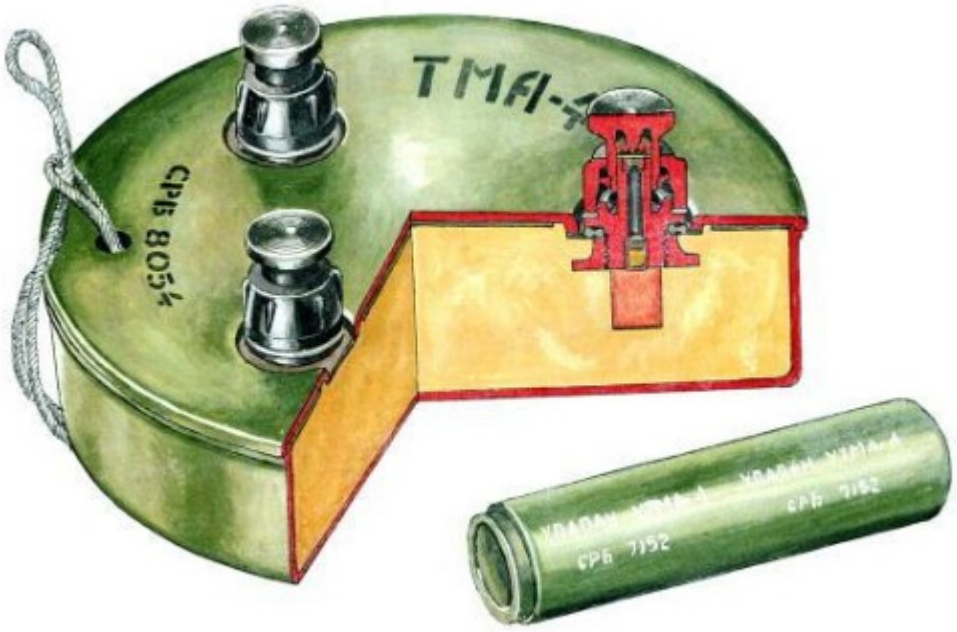
The TMA-3 was a caseless mine with a fiberglass-protected fabric handle built into the side. Three UTMA-3 pressure fuses with a pressure sleeve were screwed into the mine.

The UTMA-3 had a glued Bakelite body and a No. 8A detonator capsule. Under the plastic striker with a pressure head was a plug with a membrane and a friction-type igniter mixture.



TMA-3 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

The TMA-4 mine had a similar design in that its body was made of polystyrene, sealed to a charge of cast TNT weighing approximately 5.5 kg, and a rope handle was attached to it.



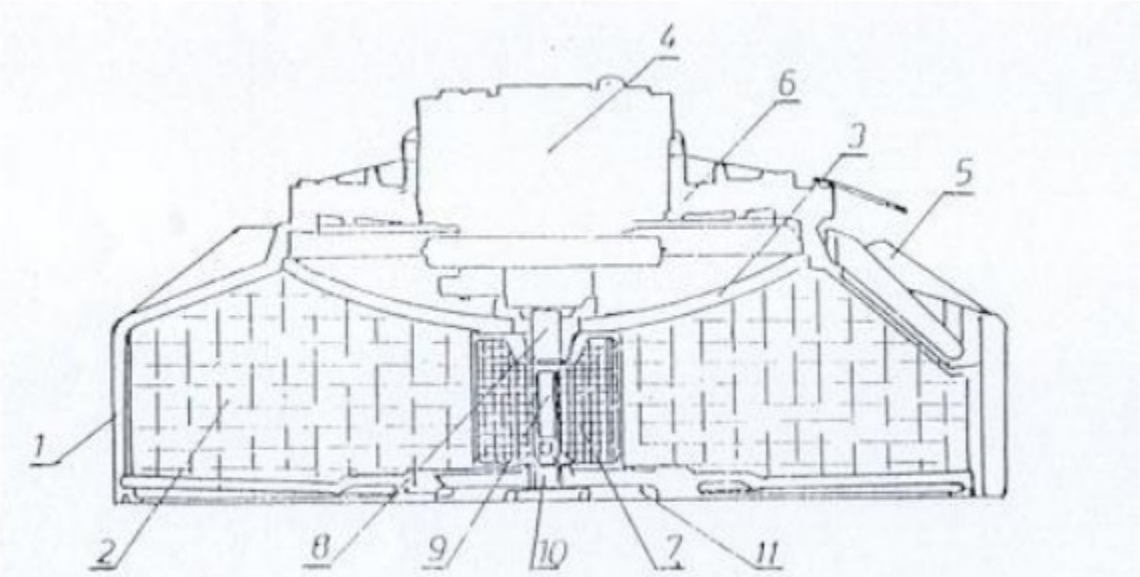
TMA-4 anti-tank anti-track mine. Illustration from the handbook Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

Three UTMA-4 pressure fuses with a pressure sleeve, under which was a striker, and under the striker, a plug with a membrane, a friction igniter mixture, and an M-17-P-2 detonator capsule used in the UPMA-2 fuse in the PMA-2 anti-personnel mine, were also loosely screwed into the mine.

This circumstance made the search for the TMA-4 mine as difficult as the PMA-2 anti-personnel mine.

TMA-4 anti-tank anti-track mine. Photo from the reference book Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King).

Yugoslavia also exported TMRP-6 anti-tank mines to Iraq, which featured a penetrator core, increasing their effectiveness on target. This mine was primarily used with the UTMRP-6 pin-type fuse, which had a 600-millimeter-long pin. The TMRP-6 mine itself had a concave disc made of high-quality steel placed above the charge.



fragmentation-piercing mine 2 explosive charge, 3 piercing — 6 (TMRP6): 1 igniter, — body, disk, 4 6-ring fuse, 7 booster bullet, 8 shim, 9 — 5 carrying handle, portable explosive booster, 10 protective — charge Figure 108. Anti-tank cap

Anti-tank anti-aircraft mine TMRP-6. Source: "Mining and explosive devices and their application: a manual". Trajko Stevanović, Svetislav Petrović. Institute for teaching and learning resources. Belgrade 1987.

The mine weighed 7.2 kg and had a ribbed plastic casing, containing a 5.2 kg charge of cast TNT and an intermediate detonator made of pressed TNT, which contained a tetryl detonator, which was removed through a hole in the bottom when the mine was planted, using a saboteur fuse or an electric detonator (like a land mine).

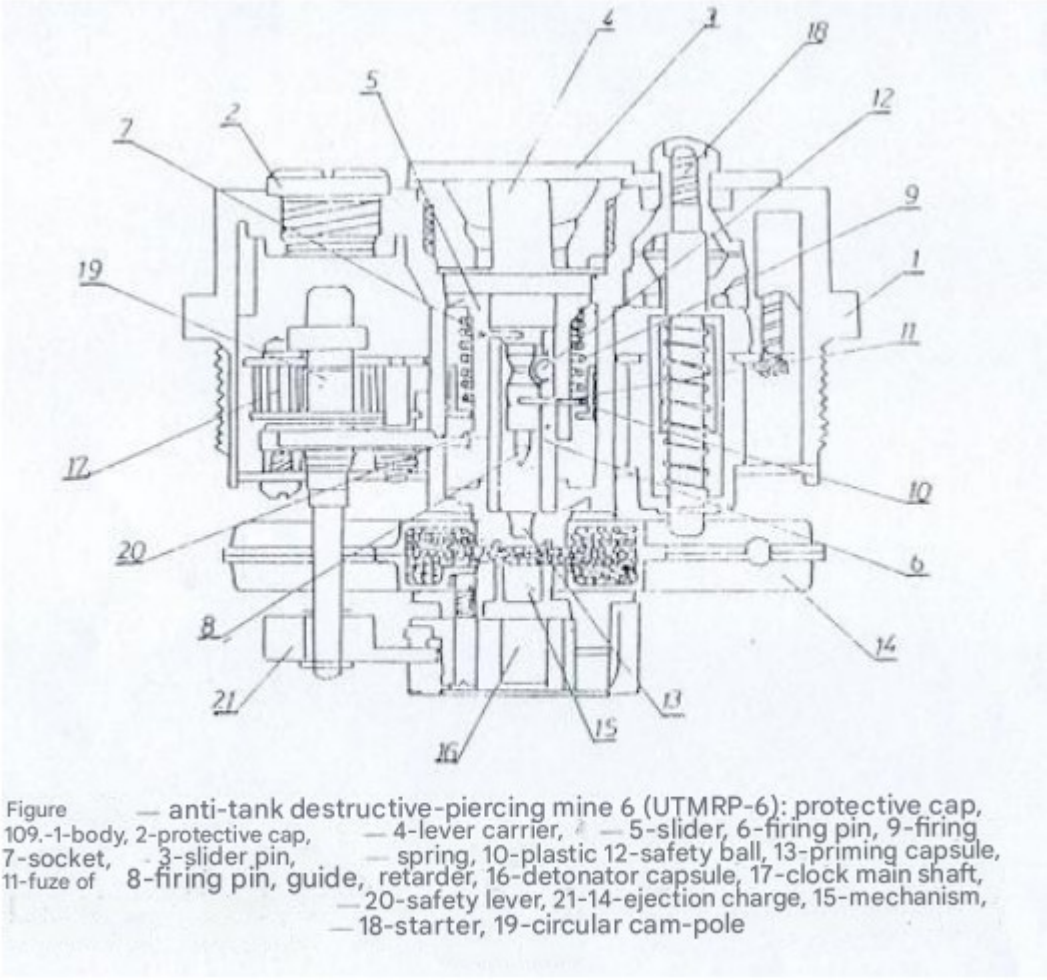


Figure 109.-1-body, 2-protective cap, 7-socket, 11-fuze of — anti-tank destructive-piercing mine 6 (UTMRP-6): protective cap, — 4-lever carrier, — 5-slider, 6-firing pin, 9-firing 3-slider pin, — spring, 10-plastic 12-safety ball, 13-priming capsule, 8-firing pin, guide, retarder, 16-detonator capsule, 17-clock main shaft, — 20-safety lever, 21-14-ejection charge, 15-mechanism, — 18-starter, 19-circular cam-pole

UTMRP-6 detonator. Source: "Mining and explosive devices and their applications: a manual". Trajko Stevanović, Svetislav Petrović. Institute for educational and teaching materials. Belgrade 1987.

The UTMRP-6 detonator had a remote arming mechanism, factory-set to one minute. Using a special key, installed on a shaft covered by a plastic cap (on the top of the detonator), the delay time could be increased to four minutes. The remote arming mechanism was activated by pressing the starter button, protruding above the detonator cover. Pressing the starter activated the clockwork, which armed the mine.

When the charge detonates, a metal disk forms a penetrating core, which strikes the target. According to the mine's manual, this disk, due to the sudden change in shape under the explosive force, attains a velocity of 1,500-2,000 m/s and penetrates up to 50 millimeters of vertical cast armor at a range of 10 meters, 30 millimeters at a range of 30 meters, and 20 millimeters at a range of 50 meters.

Later, mines of this class began to use less-disguising proximity fuses, and so, for the Yugoslav TMRP-6 mine, the Slavko Rodić-Bugojno factory developed a fuse of this type, the TMNU-7, and the mine with this fuse received the designation TMRP-7.

Precisely because of this mine's ability to destroy armored targets at a distance of 30-40 meters (which is impossible for mines with a shaped-charge effect), it was designed to be controlled by wires. In this case, an electric detonator was installed through the bottom opening (covered with a plug in the

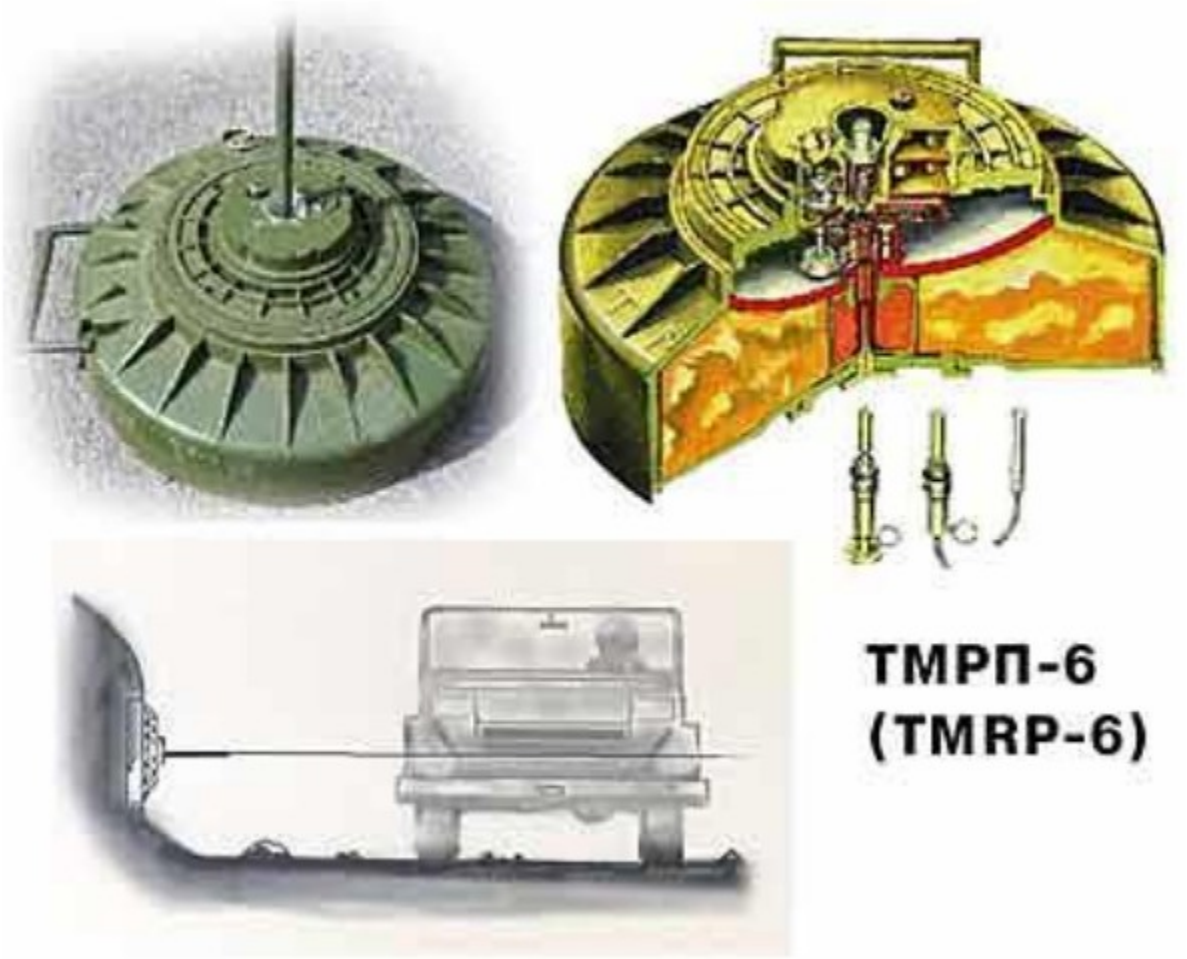
transport position) in place of the detonator, which in this case was removed from the cavity in the middle of the additional detonator.

These mines were used by the Iraqi army in Kuwait in 1991 and destroyed several US Army and allied tanks.

The use of a penetrating core made possible the unconventional use of this TMRP-6 mine with a pin fuse in the Yugoslav War as an anti-ship mine.

In this case, it is installed horizontally on those sections of the road (for example, on narrow mountain roads or in the presence of earthen or rock embankments) where it is possible to position the pin so that the target, while moving along the road, can exert pressure on it.

This mine hits the target with a penetrating core, and given that the vehicle deflects the pin by 20 degrees, the hit occurs approximately in the middle of the vehicle.



TMRP-6 applications. Illustration from Jane's Mines and Mine Clearance 1999-00 (Editor of Jane's Mines and Mine Clearance at Jane's Information Group Colin King). Author Lyn Haywood.

It should be taken into account that the impact core, having lost some of its energy in penetrating the sides of the vehicle, retains its destructive power for some distance.

It should be remembered that only the TMPR-6 is intended for this type of use, and only according to the instructions. Other foreign-made mines were not designed for such installation, as the electronic fuses of some of these mines had built-in anti-handling mechanisms that were triggered by the tilt of the fuse. Accordingly, if the mine is installed vertically, it will simply detonate after the fuse is armed.

Because of this, the use of anti-bottom mines as anti-side mines or as guided land mines is a necessary matter, however, war often requires forced decisions.

In addition, the TMPR-6 mine was also used as a river mine, when it was installed on an improvised bridge to destroy small bridges.

Sources

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